Shell Working Industries of the Indus Civilization:
An Archaeological and Ethnographic Perspective

By

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A.B. (University of California) 1974
M.A. (University of California) 1977

DISSERTATION

Submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

South and Southeast Asian Studies

in the

GRADUATE DIVISION

OF THE

UNIVERSITY OF CALIFORNIA, BERKELEY

Approved: .... Nov. 30, 1983...
Chairman Date

....

....

DOCTORAL DEGREE CONFERRED
DECEMBER 17, 1983

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SHELL WORKING INDUSTRIES OF THE INDUS CIVILIZATION:
AN ARCHAEOLOGICAL AND ETHNOGRAPHIC PERSPECTIVE.

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by

Jonathan Mark Kenoyer

This Dissertation is dedicated to
my parents, Dr. Quentin D. Kenoyer
and Marleah J. Kenoyer.

Acknowledgements

This dissertation is a result of my deep appreciation and love of the cultures and traditions of South Asia. It is a great pleasure to have an opportunity to express my gratitude to the many people and institutions that have helped in making this research possible. First I would like to thank my parents, Dr. Q. D. Kenoyer and Mrs. M. J. Kenoyer for going to India as missionaries so that I had the good fortune to be born and raised there, in an environment that has inspired me to devote my life to the study of its ancient history. My choice of shell industries as a topic is closely related to my early exposure to the traditional cultures of Bengal and Assam, where shell ornaments still play an important role in everyday life.

These interests would never have found expression if it hadn't been for the support and guidance of Dr. George F.Dales, who gave me my first opportunity to work in South Asia, at the site of Balakot, Pakistan. No words can sufficiently express my appreciation for his encouragement and direction, from the time I conducted my first experimental study of shell bangle manufacture at Balakot, to the final completion of this dissertation. My academic training in experimental archaeology and ethno-archaeological research has been greatly influenced by Dr. J.Desmond Clark, and I would like to express my sincere gratitude for sharing with me his long experience in this field, his valuable suggestions and his critical

discussions. In the organization and analysis of my data, as well as the final typing of the text, many hours have been spent at the computer in the Quantitative Anthropology Lab. I wish to thank Dr. W. Geoghegan for his patience and understanding in teaching me how to utilize this immensely valuable tool.

Most of my research was conducted in India and Pakistan during 1981-82 through the support of a Fulbright-Hays (D.D.R.A.) Grant. Supplemental research was carried out in Pakistan during the winter of 1983, funded by a Smithsonian Research Project Grant. I owe a great deal of thanks to Ms. Francine Berkowitz and her staff at the Smithsonian for their help and cooperation in processing my application on very short notice. My research in India was greatly facilitated by the efficient administration and bureaucratic organization of the United States Educational Foundation in India, then directed by Mr. Rama Krishan. Many thanks to all the staff at U.S.E.F.I. in New Delhi, Calcutta and Bombay, especially Mr. Nehru, Prof Ashim Datta and Dr. Malik. Similarly, in Pakistan I am indebted to the thoughtfulness and organization of the United States Educational Foundation in Pakistan, directed by Dr. Bruce Lohof and his staff. During both of my visits to Pakistan, I was provided every available facility at the U.S.Consulate (U.S.I.S.) in Karachi, and wish to specifically thank Mr. P. Rappaport, Mr. F. Florey, Mr. W. Jones, Mrs. S. Austrian and Mrs.P. Wood for their efforts in arranging

lectures and places to stay. My many trips to Karachi were made more memorable because of the friendship and hospitality of Bob Boise. In Lahore, my stay was made much easier by the generous provision of Mr. S. Ross and Mr. L. Belaise at the Lahore American Center and the hospitality of the Berkeley Urdu Program. At U.C. Berkeley, my graduate study has been supported primarily through language study grants (N.D.F.L. and F.L.A.S.) and I wish to thank all concerned for processing my many applications, leaves of absence for field research, late registration etc. and especially for their trust and confidence in my potential.

It would have been impossible to conduct any of my research in India without the support and encouragement of the Archaeological Survey of India, and I wish to express my gratitude to the Director General, Dr. B.K.Thappar and Director of Explorations, Dr. J.P.Joshi for permission to study the collections in their charge. In the course of my numerous contacts with the A.S.I. I found much help, encouragement and many new friends. Discussions with Dr.M.C. Joshi, Dr. K.N.Dikshit. Dr. C. Margabandhu, Kumari Madhu Bala and many others proved most valuable in the location of materials and literary sources. I would also like to express my deep gratitude to Dr. S.P. Gupta and Dr. S. Asthana of the National Museum for their many discussions and their longstanding friendship. The archaeological material from Lothal was studied at the

Western Branch of the A.S.of India in Baroda, and I would like to thank all of the staff there for taking the time to locate and unpack numerous boxes of shell artifacts; special thanks to Dept. Dir. B.M.Pande, Dr. Nagarch, D.Bhengra, P.K.Trivedi, K.D.Tripathi and S.S.Nayak.

As a Fulbright student in India, I was officially affiliated with the Department of Archaeology and Ancient History, Maharaja Sayaji Rao University, Baroda, under the guidance of Dr. R.N.Mehta. Prof. Mehta was most helpful in allowing me to study all of the shell materials from his excavations and explorations in Gujarat. I am indebted to him and his colleagues for their many discussions, encouragement and help in studying these materials, Drs. Momin, Parekh, Sonawane and Choudhury. I am greatly indebted to Dr. Kuldeep Bhan for his kindness and forethought in allowing me to accompany him on his field work in Jamnagar District, Gujarat, where I was able to examine many important new sites, particularly the newly discovered site of Nageshwar. I would also like to express my deep gratitude to Dr. K.T.M. Hegde for his enlightening discussions on the technological aspects of ancient Indus industries. My visit to the Fisheries Department in Okha was the result of discussion with Dr. Piloo of the Department of Zoology (M.S.U.) and I would like to thank Dr. N.D.Chayya, Joint Director of Fisheries, Okha and S.I. Patel, Research Officer, Sikka for providing invaluable information regarding the modern conch fisheries in the Gulf

of Kutch.

Many of the shell artifacts recovered from the excavations at Harappa and Mohenjo Daro are housed in various museums throughout India, and it would have been impossible for me to study these collections without the full cooperation of the directors and staff of the respective museums: National Museum, New Delhi; Acting Director, I.M.Mathur, P.R. Officer, L. Aditya Narayan; Prince of Wales Museum, Bombay; Director S. Gorakshkar, Curator,A.K. Andhare and Assistant, Mrs. Toraskar; Indian Museum, Calcutta; Director S.C.Roy, Curators S.K.Basu, A. Gosh and D.K. Guha. I would also like to thank Dr. A. Gosh of the Department of Anthropology, Calcutta University, for showing me the collections in their Department Museum. One of the most important study collections of molluscs of the Indian Ocean is with the Zoological Survey of India, Calcutta. I was most fortunate to have been able to examine numerous species collected from all coasts of the Sub-Continent, and would like to thank the Director, Dr. B.K.Tikader and his staff for their full cooperation; special thanks to Dr. N.V.Subbharao, A.Dey, Surya Rao, M.Gosh, B. Nath and Dr. S. Bannerjee.

The ethnographic study of shell working in modern Bengal would not have been possible without the valuable contacts suggested by Prof. A.N.Sarkar, Univ.of Chicago. Through his efforts, I was able to meet Sri A.K.Nandi, the main focus of my study in Bishnupur. Nandi Babu took me

into his home and taught me many things about shell working, the history and legends of his caste and the many socio-ritual uses of shell. His son Rabi Bhai spent many hours with me as I observed different workshops in the village, in Calcutta and in Hatgram. I can never repay the hospitality of Nandi Babu and his family because during the two weeks that I spent with them, studying, eating , laughing, singing and crying, I was able to experience the same feelings that I had as a child in Southern Assam. The other major setting for my ethnographic study was in Barrackpore outside of Calcutta. Due to unavoidable circumstances, I was unable to go to Dacca to study the famous shell workshops of that city, but fortunately it was possible to observe the traditions of immigrants from Dacca in Barrackpore. Most of my study was conducted with Ramjoy Sen, who is one of the few skilled artisans that can still cut narrow shell circlets using the large semicircular saw. I would like to thank him and his family for their cooperation and hospitality during my many visits to their village. Many other shell workers and merchants in Calcutta, Barrackpore, Bishnupur and Hatgram provided me with invaluable information. The only way that I can repay them for their information and cooperation, is by my tribute to their ancient traditions in this study and further publications.

Although much of my ethnographic research was conducted in the villages and workshops of the shell workers, I also

owe a great deal of thanks to previous researchers who provided me with information regarding the may facets of this tradition: special thanks to S. Sinha of the Census Bureau, Arun Ghatak of Calcutta University, and M.K. Pal of the Crafts Museum, Pragati Maidan, New Delhi.

Some of the most important archaeological collections that I was able to study are in Pakistan, and my research there was supported by the Department of Archaeology, Government of Pakistan. I would like to express my sincere thanks to the Director, Mohammad Ishtiaq Khan for his uncompromising cooperation and encouragement. Through his efforts I was able to study almost all of the excavated shell materials in their charge. Many of the shell artifacts were housed at the Exploration Branch, Karachi, and I owe a great deal of thanks to the Director of Explorations, Dr. Sharif and in 1983, Dr. Mhd. Rafique Mughal and the survey staff for their kindness and patience in showing me these collections: special thanks to Mr. Farooq, Muhammad Aqleem, Ashraf Khan, and Zulfiqar. It is with great pleasure that I have the opportunity to thank Selma Sultana Begum, then Curator of Moenjo Daro Museum for her every provision and her welcome hospitality during my three weeks at the site. I would also like to thank Mr. Mhd. Siddiqui who extended his full cooperation during my second visit to the site in 1983, and special thanks to the staff at the Museum; Hadis Babu, Mhd. Gafoor, and all the rest. At Harappa, I was most cordially received by the

Curator, Mr. Mhd. Siddique, and wish to express my sincere gratitude for his help and hospitality during my stay there. Other collections that I was able to study were housed at the Lahore Museum, and I would like to express my thanks to the Director, Dr. S. Rahman Dhar and the Curator, Miss Hamera Alam for their help and cooperation. At the National Museum, Karachi, Dr. Mhd. Halim was most helpful in my study of the collections there and I cannot express my great admiration for his interests in the preservation and study of the ancient culture of Pakistan.

As a Fulbright student in Pakistan, I was officially affiliated with the Department of Zoology and Marine Biology, Karachi University under the guidance of Dr. (Mrs.) N. Tirmizi. My research on the shell distributions along the coasts of Pakistan would not have been successful withour her special interest and provision for my study. No words can express my gratitude for making it possible for me to accompany her students, particularly Khalid Khan, on collections to coasts that would have been otherwise inaccessible. Special thanks to Khalid Khan and all of the other faculty and students of the Department for their friendship and support. I also owe a great deal of thanks to the Director of the Zoological Survey of Pakistan, Dr. Mhd. F. Ahmad for his assistance in obtaining their latest publications on the Pelecypoda and Gastropoda of Pakistan. Many details regarding the distributions of shell species and traditional methods of collection were obtained through

discussions with local shell fishermen. I would specifically like to thank Velji of Clifton Beach, for his interest in my study and his valuable information.

Many of the archaeological collections that I studied in Pakistan are from sites that are still being excavated or have not yet been published. Without the permission and cooperation of the excavators it would not have been possible to study these materials. The most important collection was from the site of Mehrgarh and I would like to thank the Director of the French Archaeological Mission to Pakistan, Dr. J.-F. Jarrige for his unstinted generosity in allowing me to study all of the excavated shell materials from the site. Special thanks to C. Jarrige, M. Lechevallier, A. Samzun and G. Quivron for taking time from their busy schedules to show me these materials. Although I was unable to study all of the excavated shell materials from Allahadino, I wish to thank Dr. W.A. Fairservis for his permission to study them and also Mrs. P. Turnbull, of the Field Museum of Natural History, Chicago, for sharing with me her own analysis of some of the shell materials. My study of the Balakot shell artifacts has been carried out over several years and has been continuously supported by the interest and encouragement of Dr. G. F. Dales. I also wish to thank Richard Meadow for his many discussions and for keeping an eye out for shell while sorting the large quantities of osteological materials. Just before leaving Pakistan in 1983, Dr. R.

Mughal took the trouble to show me the shell materials from his recent surveys in Cholistan. I cannot sufficiently express my gratitude for his thoughtfulness and continued support over the many years since I first studied the Early Harappan culture in his class at U.C. Berkeley.

In 1983 I was invited to join the IsMEO/RWTH Joint Moenjo daro Project by the Directors, Dr. M. Tosi and Dr. M. Jansen. It was a great pleasure and learning experience to be able to participate in their important and exciting research, and I would like to express my sincere gratitude to them and their colleagues for many stimulating discussions, suggestions and a great time at Mohenjo Daro; special thanks to Masimo Vidale, Alexandra Ardeleanu-Jansen, Ute Franke, Thomas Urban and all the rest. Professor M.Tosi has been most helpful in my study of the shell industry, especially relating to the sites in West Asia, and it was through his efforts that I was able to study important collections from Shahr-i Sokhta and other sites at the Musee Nationale d'Art Orentale, Rome. I will always be indebted to him for his constructive criticisms of my analyses and interpretations. Special thanks to Dr. Silvio Durante for his many communications regarding the shell materials from Balakot, Shahr-i Sokhta, Tepe Yahya, etc. I would especially like to thank Dr. C.C. Lamberg-Karlovsky for providing me with detailed information regarding the shell artifacts from Tepe Yahya.

When I first became interested in the study of shell

industries I had very little training in Zoology, but through much reading and some trial and error, I was able to acquire a limited grasp of the complex indentifications and methodology of Malacology and Conchology. Unfortunately, books are often storehouses of outdated and misleading information and I would like to thank Dr. J.W. Durham of the Dept. of Palaeontology, U.C. Berkeley and Dr. Barry Roth of the California Academy of Science for their suggestions and guidance in the particulars of Chapter II and Appendix 1. Although the main focus of this dissertation has been on prehistoric cultures, I have received much guidance from Dr. R. Goldman and Dr. Sally Sutherland in the discussion of the literary evidence from various Sanskrit sources. Dr. Bruce Pray has been most helpful in going over several of the chapters editorially, but beyond this he has provided vital encouragement and inspiration throughout my academic career at U.C.,Berkeley.

There are many more individuals who have, in one way or another contributed to the success of my research and writing. It would not be possible to thank each of them individually, but I wish to especially thank all of the non-academic individuals that made my visits to India and Pakistan pleasant and successful. No words can express my eternal gratitude to friends, family and colleagues who have supported and encouraged me through this lengthy process. I greatly appreciate the steadfastness of my friends in putting up with my "disgusting" self-discipline in avoiding

them to work long hours at writing.

Note: All artifact illustrations have been made by the author with permission from the respective authorities; Archaeological Survey of India, Department of Archaeology and Museums, Government of Pakistan, and/or the original excavators. In keeping with the requests of these authorities and with regard to copyright laws, no illustrations in this dissertation may be reproduced without specific permission of the author.

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CHAPTER I. INTRODUCTION

For many years, archaeologists and prehistorians studying the Indus Civilization have concentrated on the major features of architecture, pottery, plastic arts and the enigmatic Indus script, giving only passing attention to the numerous types of "minor" artifacts. The object of these studies has been to make plausible reconstructions and interpretations regarding the development and structure of this ancient society, which was undoubtedly one of the largest and possibly the most complex urban societies of the ancient world. As will be discussed below (General State of Research), many of these interpretations have remained general in nature, relying on tidbits of information obtained from the cursory examination of certain outstanding features. In many cases, the initial observations and interpretations have been substantiated by later detailed studies, but other important reconstructions have been discarded with the discovery of new data. One important field of study has been the reconstruction of temporal and cultural connections between the Indus Civilization and the contemporaneous civilizations of Western Asia, particularly Mesopotamia. This focus on external contacts has given impetus to the study of a very small range of archaeological features that might help in developing a better under-

standing of these contacts. An unfortunate result of this approach has been the deemphasis of studies relating to the internal structure and content of the Indus Civilization itself. The field records and many of the artifacts recovered by the early excavators of the major sites have never been fully analysed , leaving important gaps in the basic reconstruction of this culture. Now by concentrating on more precise technological and stylistic analyses it has been possible to understand a great deal more about the people who developed and used these objects. Recent excavations at smaller provincial urban centers and rural sites have begun to widen our perspective on the socio-economic structure of the Indus culture, primarily as a result of the concentration on problem oriented studies of specific artifact groups and other archaeological features.

In this dissertation I have chosen shell artifacts as an important indicator of technological, socio-economic and socio-religious developments in the rise of urban society in South Asia during the 4th and 3rd millennium B.C. It is the purpose of this dissertation to develop a more detailed and reliable understanding of these developments in order to better interpret the cultural traditions of the Indus Civilization and their impact on contemporaneous and later civilizations in Asia.

Research Methodology

When the first large scale excavations were begun at Mohenjo Daro in the 1920's under the direction of Sir John Marshall, archaeology in general and specifically Indian Archaeology was in its infancy. The primary objectives of the excavations were to find out what lay under the surface and then relate those artifacts to "known" civilizations in West Asia and Europe. Systematic excavation and recording was carried out, and vast quantities of artifacts were collected, but only general studies were conducted on these artifacts, leaving Marshall with the impression that as a rule, minor antiquities showed little variation in type (1931:10). Fortunately, excavations were continued at the site by E.J.H.Mackay in the 1930's, and these were more specifically designed to answer questions about the extent of the site, the intra-site chronology and the nature of the different habitation complexes within the site. Mackay's interest in technology and the material culture, resulted in several valuable studies of specific classes of artifacts. These studies enabled him to reconstruct and describe many important aspects in the daily life of the ancient inhabitants, and to develop certain hypotheses regarding the socio-economic structure of the Indus Civilization (Mackay, in Marshall,1931; Mackay,1938). During this same time, M.S.Vats was directing excavations at the equally large site of Harappa, where he recovered much important new data

regarding the development of this large urban civilization. However, in his report of the findings he relied heavily on Marshall's and Mackay's studies of the material culture for comparative and interpretive purposes, without conducting any detailed studies of the artifacts themselves (Vats,1940:i). Mackay went on to excavate the site of Chanhu Daro, and his report of the craft activities, particularly bead maufacturing, is extremely valuable for understanding the role of this site in the economic sphere of the lower Indus Valley (Mackay,1943). Many of the studies made by Mackay and his colleagues were quite comprehensive and often times conclusive, but others were more general and somewhat speculative in nature. Together , these initial studies provided the basis for subsequent scholars in their reconstruction of craft specialization and other socio-economic features of the Indus Civilization in general.

With the arrival of Sir Mortimer Wheeler and his highly developed techniques of stratigraphic excavation and recording, the chronological problems encountered by the earlier excavators were partially solved (Wheeler,1947 and 1968). Wheeler, however, did very little to enhance the study of material culture except in the realm of ceramic studies, where he was aided primarily by Leslie Alcock. Consequently, during the 60 years, following Marshall's excavations at Mohenjo Daro, all references to Harappan material culture, and their socio-economic implications,

have been based on the the initial investigations of Mackay and his contemporaries. Hundreds of sites have been located in the Indus Valley and adjacent regions that have been labeled as "Harappan" on the basis of similarities in pottery types, the presence of Indus script and various other criteria that have accumulated over the years. In describing the material culture of these sites, the excavators continue the tradition set by Vats, relying on the descriptions and interpretations given in the early reports, without conducting detailed analyses of their own new collections. This reliance on earlier studies, which were themselves preliminary and limited in scope, has resulted in a narrow perspective on the internal developments of the Indus culture and its important regional variations.

A very few scholars have attempted to correct this deficiency by conducting additional studies on specific classes of artifacts; D.P.Agrawal (1970 and H.C.Bharadwaj (1965-66) on metal working; B.Allchin (1973,1979) and Kenoyer (1983) on the lithic industry ; Dales and Kenoyer (1977) on shell working; Dales and Kenoyer (in press) on pottery; Halim and Vidale (1983) on aspects of pyro-technology. These studies are all interconnected in that they ask specific questions about the technological structure of Harappan industry, some from the detailed perspective of a single manufacturing process at a specific site, and others from an overview of all similar artifacts

recovered from all the different regions of the Indus Civilization.

Both approaches have been extremely valuable because of the large amounts of concrete data that they can provide. This data makes it possible to reconstruct the technological developments of a craft or industry and thereby develop more reliable hypotheses regarding the socio-economic structure within which the industry existed. In this study we will be concentrating on two types of development; the development of specific techniques and tools for the manufacture of different objects from shell, and the development of trade/exchange networks for the distribution of shell raw materials and shell artifacts.

By definition, an artifact is an object that has been used or modified by man, and because of the fact that shells do not usually occur naturally in archaeological deposits, almost any fragment of shell recovered from excavations can be considered an artifact. The exceptions are those species of terrestrial or freshwater mollusca that inadvertantly become included in archaeological sediments or building materials. Some shell artifacts are more important than others because of the technological and socio-economic information that they can provide. This information is a result of modification through various processes of manufacture or production.

Theoretically, an artifact that has passed through numerous stages of production can provide more information

than one that has been only slightly modified. One of the most important factors in selecting shell artifacts as the focus of this dissertation, is the varied and often unexpected types of information available from their study. Molluscs comprise an important source of food for many coastal populations and their shells provide an attractive, durable and versatile raw material that comes in many different natural shapes and colors. Because of these features they have been used since Palaeolithic times as food, in the production of tools and utensils, ornaments, and various other socio-ritual objects. The peoples of the Indus valley and adjacent regions had access to a vast seaboard rich in molluscan resources, and shell, in one form or another is found at almost every Indus Period site, from the coastal regions to the mountains of Central Asia.

Once a shell has been collected, it enters into a complex socio-economic system with several related subsystems; production, distribution/exchange and consumption (Kohl,1975a). The fact that these subsystems overlap makes it extremely difficult to differentiate them in the archaeological record.

Any form of production involves various stages through which a raw material must pass before it is transformed into a finished commodity. Numerous different approaches have been taken in the study of these stages, but the basic framework that applies to all types of production is:

1) acquisition of raw materials,

2) processing of raw materials,

3) distribution of finished commodity.

Within each of these basic divisions there are many different stages depending on the type of raw materials being processed and the desired final product. The choice of raw material is generally a reflection of cultural preference, except where geo-ecological factors limit the availability of different materials. Manufacturing processes, on the other hand, are delimited by the type of raw material being used, and in this context various techniques are developed to produce a specific type of object. A finished product is therefore a result of both cultural preferences and natural variables.

Raw materials as well as finished commodities are distributed through various systems of trade/exchange. The identification and classification of these systems on the basis of archaeological data has been the subject of innumerable discussions and much model building. Various overlapping models have been developed for the interpretation of the archaeological data, and although no universal models have been accepted, each approach has contributed to our understanding of early socio-economic systems (Clark,D.L.,1968; Beale,1973; Renfrew,1975; Lamberg-Karlovsky,1975; Kohl,1975a). An important observation made by Kohl is that it is not enough to simply concentrate on identifying the mechanics of trade without

first understanding its "nature" and underlying "structure", and the "organization" of the societies involved (Kohl,1975a:47). In this Dissertation we will first examine the acquisition of raw materials and the nature of production. In the context of this data we can then compare the role of production at different sites and better define the mechanics of trade/exchange. Three basic models can be applied here; 1)Direct Contact Trade, 2) Exchange or Indirect Contact Trade and 3) Central Place Trade (Lamberg-Karlovsky,1972:222-223).

Artifacts distributed through direct contact trade are produced at one site and taken to another site for distribution. Theoretically, no artifacts would be distributed along the route from the manufacturing site to the consumer. Exchange or indirect contact trade is the system by which artifacts are distributed from one region to another without any definite organization. Consequently, artifacts produced in one region would occur all along the route to the most distant consumer. The central place model represents a system where one site or region has access to a valuable commodity, either in the form of raw materials or manufactured objects. Commodities from this central region are distributed to other distant sites, and goods from mutually exclusive regions are distributed through this common axis or "central place" (Ibid.). A fourth model can be proposed relating to itinerant craftsmen/traders who travel to their markets, often with their raw materials and

finished products. It is rarely possible to distinguish this type of exchange from production because of the overlapping of the two systems. However, it is suggested that in some Indus period sites this system can be identified. The other three models have been applied to the trade of shell artifacts between the Arabian Sea and inland sites, but usually the source for different marine shells has been defined only in general terms. In this study I have tried to isolate specific coastal resource areas that were providing raw materials for different coastal and inland manufacturing centers.

Malacological Evidence

The first problem in studying these shell artifacts has been in the identification and proper classification of the different species. The majority of shell artifacts from Indus period sites were made from marine shells, and over 90 different species have been identified so far. However, there are no comprehensive malacological studies of the shell populations in the coastal waters of the Indian sub-continent, and it was necessary to spend a considerable amount of time studying modern collections at different museums in India, Pakistan and the U.S.A. in order to determine the acceptable nomenclature for specific mollusca and to locate their possible source areas.

As will be discussed in more detail below and in Chapter II, this phase of the study is extremely important

for determining the modern source areas for different species used in the shell industry and the reconstruction of their probable ancient source areas. Certain species of marine shell used by the Indus peoples have isolated geographical distributions and on the basis of these distributions it has been possible to reconstruct specific trade and exchange networks connecting coastal source areas to manufacturing centers and finally to the consumers. In reconstructing the possible ancient source areas it has been necessary to examine the geomorphological changes in the coastal regions of the Indus Civilization. Although these coasts have not been the focus of intensive research, some valuable studies have been made regarding the geomorphological changes of the coasts of Western India over the last ten thousand years,(Snead,1967; Gupta, S.K.,1977) and it has been possible to determine the major ancient source areas for certain shell species.

Archaeological Evidence

The second phase of the study involved a detailed analysis and reconstruction of the various technological processes by which natural shells were transformed into artifacts with social and economic value. Although the early excavators of Mohenjo Daro and Harappa did not take much time in studying the waste fragments from shell working, they were careful enough to save them for future analyses. Shell artifacts from the major excavated sites

form the primary data base for this dissertation, and these have been supplemented by other collections from provincial and rural sites. The first stage in this analysis involved the recording of important morphological and stylistic features of the different artifacts in order to separate them into classificatory groups. This classification will be discussed in more detail below (Appendix 2), but it is basically an ordering system coded for use in computerized sorting, analysis and retrieval of data.

The stylistic features of beads, bangles, ladles, inlay, etc. have been defined on the basis of metrical variables and surface decoration. Chronological variations can be isolated on the basis of changes in these stylistic features. Although beads have long been used as cultural and chronological indicators, it has been difficult to obtain reliable samples from the different sites because of confusion between white shell and other raw materials. I have been able to compile the basic statistics for the morphological features, but it has not been possible to compare these from all the major sites. Shell bangles, however, do provide important metrical data that can be used for comparing stylistic changes and changes in technological traditions. The width of a bangle, and the type of surface treatment are the most reliable variables for indicating stylistic and technological characteristics of the manufacturing tradition. Other measurements, such as thickness and diameter are not reliable variables, because

they vary according to the natural structure of the shell and it is difficult to isolate cultural preferences from structural variation.

The types of samples available for my study were mostly selective samples that were varied in terms of their representative reliability. Due to the fact that not all shell was recognised as such by the early excavators, very few counts of total shell artifacts have been provided in the various excavation reports. Without this information, it has often been impossible for me to determine what percentage of collected shell is represented by my recorded samples. Keeping these factors in mind, I have kept quantitative discussions to a minimum and have carefully qualified any interpretations on the basis of what can be gleaned from the excavation reports, the original field registers and personal surveys of the sites and site dumps.

In addition to finished artifacts, I have concentrated on the recording and analysis of all types of manufacturing waste resulting from shell working. A considerable amount of manufacturing waste has been collected at urban and coastal sites, and by comparing the frequency of finished items and manufacturing waste, I have tried to differentiate manufacturing centers producing artifacts for internal consumption from those producing artifacts for trade. Most of the manufacturing processes can be reconstructed from the examination of the waste materials, but in some cases it is difficult to determine the precise process involved.

Therefore a separate experimental study was undertaken to replicate various objects using both ancient and modern tools. Some of the replication was done by the author himself and other experiments were conducted with the cooperation of modern shell workers in Bengal. These shell workers still use traditional techniques that have roots as far back as the prehistoric period, and these living traditions make it possible to better understand specific tecnological aspects of the prehistoric shell industry and gain new perspectives on the possible socio-economic structure of this industry within the larger context of the Indus Civilization.

With this scientific and technical background, it was then possible to isolate stylistic features of specific shell artifacts that are not simply a result of the manufacturing processes needed to work a particular form of shell. The Indus shell workers chose different species to manufacture specific objects and these choices reflect cultural preferences that can be used as cultural and chronological indicators. Some shell artifacts are relatively unimportant in terms of their interpretive value because they occur in a wide range of cultural contexts over many thousands of years. Others can be dated to specific time periods and traced from major manufacturing centers to distant regions as far as Afghanistan, Iran and Iraq (Mesopotamia). Because of the limited scope of this dissertation, I have not included a detailed study of the

shell artifacts from Mesopotamian sites. However, it has been necessary to include certain examples to illustrate the wide distribution of shell artifacts produced in the Indus workshops. I have also kept my discussion of trade and exchange limited to the movement of goods within the greater Indus Valley region and have only briefly touched on the discussion of external trade.

Ethno-Archaeological Evidence

Shell artifacts were undoubtedly used in a wide range of socio-economic and socio-religious contexts, but functional interpretations have been extremely difficult without the support of any textual evidence. The function of some shell artifacts can be more reliably interpreted because they occur in specific domestic contexts or show evidence for use as tools. Others appear to have been worn as ornaments or were used in ritual contexts, such as burials, but most shell artifacts remain unexplained. Therefore, it has been necessary to examine their occurrence in other related cultures where there is both archaeological and textual evidence. In Mesopotamian sites we find this optimal situation during the same time period, suggesting that shell may have had important ritual functions in addition to its social and economic uses. There is now sufficient evidence to prove that cultural contacts existed between Mesopotamia and the Indus Valley (see Ratnagar,1981 for bibliography, Shaffer,J.G.,1980) and a comparative study

of the uses of shell objects in these two radically different cultures will help provide new insights into the development and structure of their socio-religious systems.

Another approach has been to examine the occurrence of shell during the Late Indus and Post Indus periods (approximately 1700 B.C. to 1000 B.C.). Archaeological evidence from sites in Pakistan and Western India has been examined and indicates that there was a continuity in the use of shell at the sites in Kathiawar, whereas in the Punjab and northern regions, there was a hiatus. During the subsequent periods, at sites with Painted Grey Ware (1200 B.C. to 600 B.C.) and Northern Black Polished Ware (800 B.C.to 300 B.C.), we see new developments related to the second major urbanization in South Asia. These two ceramic traditions overlap chronologically and have been associated with the Vedic and later Epic Periods (Lal,B.B.,1981), for which there is a large body of textual macerial, and these texts provide interesting examples of the use of shell in specific socio-religious contexts (see Chap.IV). Many of the traditions described in these texts regarding the ritual use of shell objects, were spread throughout the subcontinent during the course of Hindu and Buddhist political and religious expansion. In some regions, such as Bengal in Eastern India, these ancient traditions are still being practiced, even though they have disappeared from Western or Northern India. An important part of my research was devoted to the stuuy of the shell working and shell

using communties in Bengal. Although Bengal is quite removed from the Indus Valley geographically, it has always been closely connected to the Western and Northwestern regions by major trade networks (Puri,1965; Majumdar,R.C., 1968). Even today, although shell working has disappeared in Kathiawar, shells from the Gulf of Kutch are still being shipped to Bengal for manufacture. The living tradition of shell working in Bengal can be seen as the last remaining vestige of a much more widespread cultural tradition that was common throughout the entire subcontinent from the first millennium B.C. to the 17th and 18th centuries A.D. By observing the role of shell objects in the economic and religious spheres of this traditional community, it has been possible to gain new perspectives for understanding and interpreting the function of specific shell artifacts during the Indus Period.

Figure 1-1: GEOGRAPHICAL SETTING OF THE INDUS CIVILIZATION: circa. 2500 B.C.

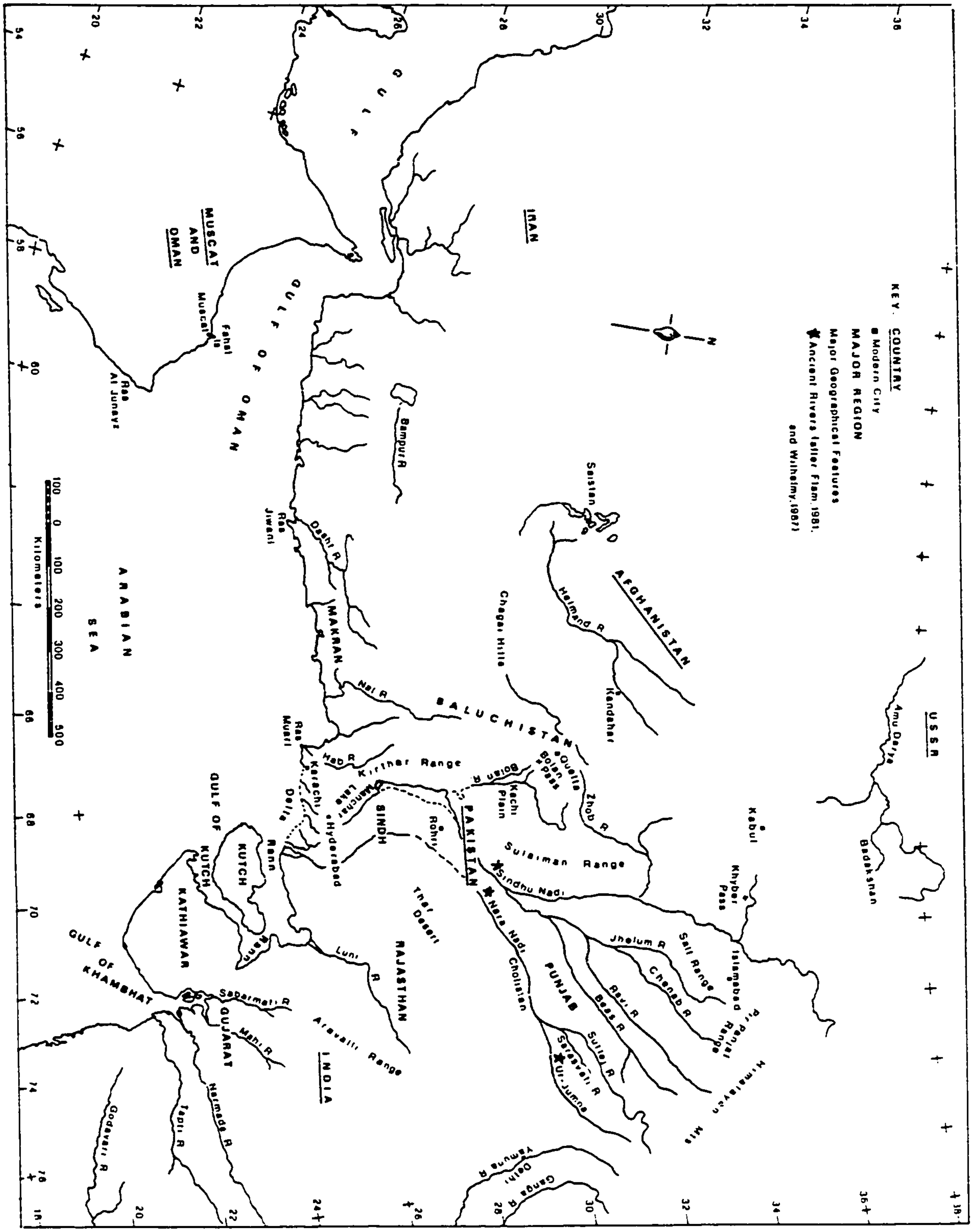
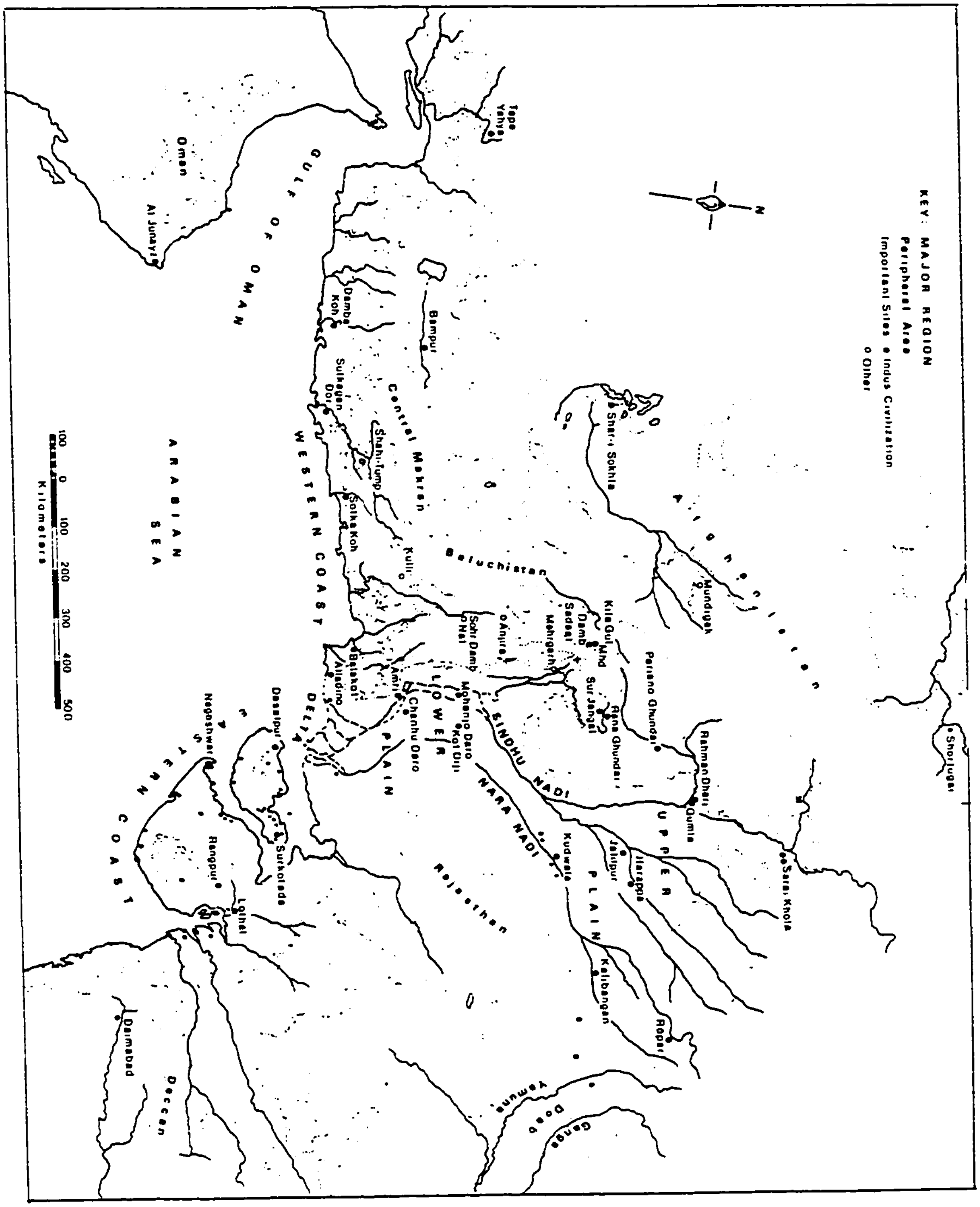


Figure 1-2: MAJOR REGIONS OF THE INDUS CIVILIZATION



Geographical Setting

One of the most striking aspects of the Indus Civilization is the geographical diversity of the regions in which sites attributed to this culture are found (Fig.1-1). A rough estimate of the total extent of this culture would be over 850,000 square kilometers, an area considerably greater than that of other contemporaneous civilizations in West Asia and Africa. Although some of the geographical regions lie on the periphery or are completely outside the present Indus valley, the great majority of sites fall within what Mughal defines as the Greater Indus Valley, dominated by the Indus River system and the ancient Ghaggar/Hakra River (Mughal,1975:40). For this reason, the term Indus rather than Harappan is used to descibe this vast civilization.

In the following study we will be looking at sites in all of the major and peripheral regions, but our main concern is with the coastal regions where different species of shell were obtained. It is not in the scope of this study to present a detailed discussion of each of the inland regions, especially since other scholars have dealt with most of them quite adequately. The ancient seaboard on the other hand has not been examined from the perspective of marine and specifically, molluscan resources, so we will examine it in more detail.

The primary setting for the urban sites of the Indus Civilization is on the everchanging flood plain of the

ancient Indus River and its tributaries. During the 4th and 3rd millennium B.C. this plain was watered by two major rivers, the ancient Indus or as Flam calls it, the "Sindhu Nadi" (1981:68) and the ancient Hakra/Nara or "Nara Nadi" (Ibid:75). This double river system has been subdivided into many different regions by different authors, depending on the analyses they were undertaking. Here we are concerned primarily with the movement of goods along riverine or overland trade routes connecting the coastal source areas with inland markets. Within this perspective the ancient Sindhu/Nara Plain can be divided into three general regions; the Upper Sindhu/Nara Plain, the Lower Sindhu/Nara Plain and the Sindhu/Nara Delta. (Fig.1-2).

In the past there was considerable discussion regarding the effects of recent climate changes on the distribution of settlements in the Sindhu/Nara plain, and the eventual decline of the Indus civilization. The concensus is that there has been no major change in climatic patterns in the region of western South Asia and Baluchistan during the last 10,000 years (Raikes and Dyson,1961; Raikes,1965). There is evidence, however, for regional fluctuations in rainfall (G.Singh,1974; Allchin,Hegde and Goude,1978; Gupta,1977a & b; Snead, 1967, etc.) and corresponding changes in environmental or geomorphological features. But, it is clear that they did not have a major impact on the rise of urbanization in the Sindhu/Nara region or its decline.

The Upper Sindhu/Nara Plain

Although geographically speaking the Upper Sindhu/Nara Plain is quite diverse, it can be seen as a single unit on the basis of the major tributary systems that flow from the northern mountain regions and join to form these two major rivers. In general, this area of Northern Pakistan and India is referred to as the Punjab (Five Waters) because it includes the five major tributaries of the Indus River; the Jhelum, Chenab, Beas, Ravi and Sutlej Rivers. In early literary sources,however, this area was called Sapta Sindhu (Seven Rivers) (cf. Law,B.C.,1954:120 Rg Veda,VIII,24,27) and extended from the Indus river on the west to the Yamuna River on the east (Fentress, 1976:60-61). The prehistoric configuration of these rivers was slightly different than what is seen today, and different scholars have attempted various reconstructions based on studies of the ancient river channels and the distribution of archaeological sites. Wilhelmy (1969) has analysed this data most convincingly and presented a reconstruction of the basic river systems in this region during the 3rd millennium B.C. The major western tributaries of the Indus River, the Jhelum, Chenab and the Ravi Rivers have not altered drastically, due to the geological formations through which they flow, but the Beas, Sutlej and Yamuna Rivers have undergone major changes due to relatively minor tectonic activities in the head waters and the resulting changes in the hydrological regimen of each river. According to Wilhelmy's reconstruction the ancient

Beas flowed basically along its present course except for the fact that the Sutlej did not join it. The ancient Sutlej or Ur-Sutlej (Wilhelmy,1969:90-91) with its minor tributary, the Sarasvati, joined the ancient Yamuna or Ur-Jumna (Ibid.) to form the Hakra/Nara River, or rather the Nara Nadi. Both the Sindhu Nadi and the Nara Nadi carried large quantities of snow melt and monsoon run-off, which contributed to massive flooding in the aggrading alluvial plain to the south and southeast (now the desert of Cholistan). At different prehistoric and historical periods, the waters that used to feed the Nara Nadi came to be diverted into either the Indus system or the Yamuna-Ganga System, resulting in the complete dessication of the alluvial deposits along its entire length. During the 4th and 3rd millennia however, it provided arable land for the development of numerous agricultural settlements. In summary, the Upper Sindhu/Nara Plain is basically equivalent to that defined by Fentress as the Upper Indus Plain (1976: 61), delineated by the Himalayan Mountains to the north, the Suleiman Range to the southwest, the Yamuna River to the east and the encroaching Rajasthan desert to the south. The major relief in this region is the Potwar Plateau in the western Punjab, the Salt range and the Pir Panjal to the east in Kashmir. The remainder of the region is made up of terraced and flat alluvial plains.

The Lower Sindhu/Nara Plain

There is no specific geographical feature that separates the Upper Plain from the Lower, but there are ecological differences in terms of rainfall and temperature (Fentress,1976:64). Basically, the Upper Plain receives more reliable rainfall than the Lower Plain, and because of the northern latitude, the average temperatures are slightly lower. The Lower Plain is made up almost entirely of alluvium, bordered by the Kirthar and Sind Kohistan Ranges on the west, the Rajasthan and Thar Deserts to the east and the wide expanse of the delta to the south. The Bolan River flows into the Indus or Sindhu Nadi from the west, and it has built up a substantial alluvial plain at the base of the Baluchistan Mountains known as the Kacchi Plain (Jarrige,1977).

Two major rock outcrops occur at the Rohri Hills in the north and at Ganjo Takar or Makli Hills in the south. The Rohri Hills are made of limestone, with large masses of chert that have formed in the irregular hollows of the limestone matrix. Presently the Indus River is captured between a low pass in these hills at Sukkar/Rohri, but Flam (1981) presents a convincing summary of evidence for a more western course during the 4th and 3rd millennium B.C. The Nara Nadi flowed to the east of these hils in a course more or less parallel to the Sindhu Nadi. In Flam's reconstruction, the major site of Mohenjo Daro would have been between the two rivers rather than on the Indus

(1981:82-84). His evidence for the general westerly flow of the Sindhu Nadi does not exclude the possibility that a major river channel flowed near the site, and further research needs to be done on this question.

Another important feature of the Lower Sindhu/Nara Plain is the ecologically distinct area of Manchar Lake. This shallow lake is located at the southern end of the Kirthar Range in an alluvial pocket formed by an eastern extension of the mountain range. During flood season, it is often inundated by water from the Indus River, through the Eastern Nara channel, and later, during the dry season, some of this water flows back into the Indus. The lake is never completely dry, and supports numerous freshwater molluscs. The size of the lake fluctuates considerably depending on the drainage of water from the main river system and the local runoff from the Kirthar Range. Flam has reported the presence of what appear to be 3rd millennium sites in areas presently inundated during the monsoon period (Flam, pers. communication).

The Sindhu/Nara Delta

Modern reconstructions of the 4th and 3rd millennia delta of the Sindu/Nara river system are based on a general reconstruction of the rate of aggradation of the lower Indus basin during the late Pleistocene and Holocene, as well as the discovery of prehistoric sites along the peripnery of the modern delta. The most recent study by Flam (1981)

summarises the results of the relatively few major geological studies in this region (cf. Flam; Lambrick,1975; Brinkman and Rafiq,1971; Fraser, 1958;etc.). He points out that " The infilling of the lower Indus basin with alluvial sediments has been the primary factor of landform development from the Pleistocene to the present day, "(1981:66) and that during the Pleistocene, with sea levels similar to those of today , the "...coastline moved northward to somewhere between Hyderabad and Sukkar "(1981:63). (See below for discussion of changes in sea level.) In the middle Holocene, the hydrologic regimen of the river changed to an aggrading system, due to a slight decrease in rainfall, which was less than in the early Holocene, but similar to modern standards. Even though the sea level remained fairly constant, "... the estuary plain and the coastline of the lower Indus basin began a relatively rapid movement southward due to delta building"(1981:64, cf. Brinkman and Rafiq,1971:18). Numerous studies of ancient river channels and early historical accounts have resulted in a concensus that the ancient rivers joined somewhere on the eastern side of the lower plain, north of the present day Rann of Kutch (Flam,1981:85). The distribution of Pre-Harappan and Harappan sites in the lower plain allows for a general outline of the limits of the delta region, and although many smaller sites may have been covered by later alluvium, it can be assumed that these sites reliably represent the major

habitational expansions in this region during the 4th and 3rd millennium B.C. (Flam,1981:Fig.25).

The molluscan resources of the delta would have been very similar to those found in the modern delta of the Indus River. Most of the estuarine species have relatively thin shells that were not suitable for manufacturing the types of objects produced in the Indus workshops. Consequently, we find very few examples at the inland sites, and their occurrence at the coastal sites is usually related to subsistence rather than production. Basically, the molluscan resources of the delta region are not significant for this study, and since the major species that were used in the shell industry do not normally occur in delta habitats, we need not look to this region as an ancient source area.

West of the Sindhu/Nara Plain, the Indus Civilization penetrated into some of the narrow valleys of the Baluchistan Mountains, but the most important settlements were along the Sindh and Makran coasts, west of the Sindhu/Nara delta. This will be referred to as the Western Coast. The other major extension of the Indus Civilization occured to the east and southeast of the delta, extending throughout Kutch, Kathiawar and Saurashtra, as far as the west coast of Maharashtra. This will be called the Eastern Coast.

The Western Coast

From the delta of the Sindhu/Nara Rivers the Western Coast includes the modern bay of Karachi, Sonmiani Bay and the entire Makran coast as far as the mouth of the Dasht River, at the border of Iran and Pakistan. Although this region is presently divided between the states of Sindh, east of the Hab river and Baluchistan, west of the Hab River, geologically it forms a more homogeneous unit, consisting of rocky shores interspersed by desert alluvial plains and wide sandy beaches. The most comprehensive study of recent geomorphological changes of this region was made by Snead (1967,1969) and Snead and Erickson (1977). One important feature of this coast is its tectonic activity, which results in the sporadic appearance of mud volcanoes, mud islands and local uplifting of the coast (Snead, 1967: 551-552). These minor tectonic movements are seen on a larger scale in the gradual emergence of the entire coast west of Karachi, as far as Ras Jiwani (Ibid.:552-554). The dating of the numerous and varied uplifts poses a difficult problem, but examination and comparison of marine benches having unweathered oyster beds suggests that "...the uplift was greatest, about 300 to 400 feet along the western section of the Makran coast, decreasing to six to eight feet in the Indus delta region (Ibid.:557). Without coming to any definite conclusions on dating, Snead suggests that some of these uplifts may be as recent as "pre-World War II" , but not older than 3000 to 5000 B.P. (Ibid.;564-565). The

older date is determined by the presence of Indus period sites along the coast that were possibly sea ports or fishing villages, but are now located far from the coast. Sutkagen Dor on the Dasht River is at the western end of the coast and is now about 50 meters above mean sea level and some 79 kilometers inland (Dales,1962). Towards the eastern end of the coast, the site of Balakot has a much lower elevation (only 9.7 meters above the plain level) and is about 12 kilometers from the modern fishing village of Sonmiani (located on Sonmiani Bay)(Dales,1974). The implications are that there has been more uplift and instability along the western coast and less in the east, and that these changes occurred during or after the occupation of the Indus civilization sites of Sutkagen Dor and Balakot. Consequently , the site of Sutkagen Dor may have been much closer to the sea, in terms of both distance and elevation, whereas the situation at Balakot is probably much the same today as it was during the 4th and 3rd millennia B.C.

Both of these sites are located on the two major alluvial deposits along this coast, the Dasht River Plain and the Las Bela Plain. Further east the perennial Hab River flows along the western base of the Kirthar Range, while the Layari and Malir rivers flow to the coast on the east.

Although most of the uplifted beaches on the western coast can be attributed to tectonic activity, there is the

possibility that some of them may have been formed during periods when the sea level was higher than it is today. Studies along the Saurashtra coast have indicated that around 6000 B.P. (5th to 4th millennia B.C.) the sea level was two to six meters higher than it is today (Gupta,1977a:181). Snead feels that in some areas, "sea level changes have had more influence upon the coastline than tectonic movements", but because of the complex inter-relationship between sea level changes and intermitent uplift along this entire coast it is difficult to isolate one from the other (1967:557). He suggests that by the 3rd millennium B.C. the sea level had reached its present level from a considerably lower level during the Lower Pleistocene, and that some of the higher marine benches may be attributed to minor fluctuations during the Holocene, but these fluctuations did not have a significant effect on the overall geomorphology of the Eastern Coast, specifically along the Karachi and Sonmiani coast (Snead and Erickson, 1977:14,33).

Taking into account the geomorphological changes along the Western Coast, we can reconstruct certain aspects of the marine habitat in order to isolate ancient molluscan resource areas. The specific habitats for each of the major species used by the shell workers will be discussed in the following chapter, but generally speaking we are concerned with protected, shallow bays with sandy bottoms, rocks and reefs interspersed with sandy areas, and protected lagoons

and backwaters. The coast east of the Kirthar range, from Ras Mauri (Cape Monse) to the mouth of the Malir River has probably remained basically the same, because it has not been drastically effected by delta building , by major tectonic uplifts or by major sea level changes. Here we have numerous small estuaries and backwater areas connecting the Malir and Layari rivers to the larger Bay of Karachi. This bay has several rocky islands and wide sandy beaches that continue west to Hawkes Bay, and Ras Mauri (Cape Monse). West of Ras Mauri, Gadani Bay and Sonmiani Bay are also well protected, and have alternating stretches of sandy beach and low reefs or rocky outcrops. West from Sonmiani Bay, however, the coast becomes much more rugged, with narrow beaches bordering sharp underwater ridges, and only small bays at Pasni, Gwadar and Jiwani. The tectonic instability along this portion of the coast is not confined to the Holocene, but has been occurring since much earlier periods, and it is unlikely that any major populations of the larger species of gastropod used during the Indus Period developed in this region. This question will be more satisfactorily resolved when upraised marine benches can be properly studied to determine the different species living along this coast prior to the 3rd and 4th millennium B.C.

The Eastern Coast

This region is more diverse than the western coast and there have been some major changes in the coastal morphology since 6000 B.P. On the basis of these changes, we can subdivide the region into three major land areas: Kutch, Kathiawar/Saurashtra and the plains of Gujarat; and three major coastal regions, the exposed coasts of Kutch and Kathiawar, the prehistoric Bay of Kutch and the Gulf of Khambhat (Cambay).

Kutch is essentially a low island made up of shifting sand dunes, some stable land areas, rocky outcrops and marshy salt flats (Allchin, et al.,1978:7). Presently it is connected to the mainland by the seasonally dry salt flats of the Rann of Kutch, but during the monsoon the Rann is inundated by floodwaters and brackish sea water (Joshi,J.P.,1972:99). Numerous researchers have demonstrated that the present character of the Rann is a recent development and that several factors have been involved in this change; sedimentation, tectonic movements and minor changes in mean sea levels.

Looking first at the western portion of the Rann, known as the Greater Rann, we see that it is fed by two major river systems, the ancient Sindhu/Nara Nadi and the Luni River. The delta sediments of the Sindhu/Nara system eventually filled up most of the western mouth of the Rann, while the Luni is still bringing silt into the eastern portion. Further to the east is the Lesser Rann, into which

several rivers drain, the major ones being the West Banas and the Saraswati. Gupta reports an average sedimentation rate of 2 mm per annum for the Lesser Rann, and attributes its present character primarily to the accumulation of silts (Gupta,1977b:205). In the northern portion of the Greater Rann, there is evidence for local tectonic movements resulting in numerous uplifts , the Allah Bund being one of the most recent (1819 and 1839). The localized emergence at the mouth of the Sindhu/Nara System resulted in the blockage of water flow and the drainage of certain parts of the Greater Rann (Roy and Merh,1977:199). Possible changes in sea level may have had a more general impact on not only the Rann and Gulf of Kutch, but the entire coast of Kutch and Kathiawar/Saurashtra. Gupta's study of the Saurashtra coast noted the presence of numerous raised beaches, from two to seven meters above present day mean sea level, and up to two kilometers inland. In the absence of evidence for tectonic uplift, and with carbon 14 dates (made from shell and coral) of 6000 B.P., 30,000 B.P. and 120,000 B.P., he suggests that these beaches represent sea levels of two to six meters higher than today, during corresponding interstadial and interglacial periods (Gupta,1977a:181). Furthermore, he states that up to about 2000 years ago, the Lesser Rann of Kutch was about four meters deep and inundated throughout the year (Gupta,1977b:205). Further research in this region will undoubtedly be able to determine whether these changes can be attributed to worldwide climatic fluctuations or are

only local fluctuations. Regardless, for the present we can reliably assume that there was a shallow bay that we shall call the Bay of Kutch, which included those areas covered by the present day Rann of Kutch and Gulf of Kutch.

Looking at the marine resources in the Gulf of Kutch today, we can try to reconstruct the basic molluscan habitat areas during the 3rd millennium B.C. Along the southern shore of the Gulf there are numerous reefs interspersed with sandy areas. Both of these habitat areas support significant populations of the major large gastropods used in the Indus shell industry. The northern part of the Gulf is quite different and is characterised by shifting underwater dunes and no major reefs. This type of habitat is not suitable for the development of large concentrations of these gastropods. The southern areas of the ancient Bay of Kutch, extending from the modern mouth of the Gulf up through the Lesser Rann, was probably very similar to the habitat presently seen in the Gulf of Kutch. The northern part of the Bay may also have had a similar division between the northern and southern portions. Along the southern part of the modern Greater Rann, the presence of numerous small rocky islands suggests the presence of buried reefs, similar to those in the Gulf of Kutch, where large populations may have existed before they were silted up. In the northern portion, where there is evidence for considerable silting by several river systems, it is unlikely that any of these species would have survived

The second major land area is the peninsula of Kathiawar/Saurashtra, which in the past was also partially isolated from the mainland by marshy wastes and tidal flats. Presently, there are wide alluvial areas, salt flats and a major lake (Nal Lake) extending from the southeastern edge of the Lesser Rann of Kutch, towards the Gulf of Khambhat. The ancient site of Lothal is precariously situated in the middle of the alluvial plain with the Sabarmati River flowing to the east and the Bhogava to the west (Rao,1978:8). Much of this area is inundated during the monsoon season, and during th 3rd millennium B.C. this area was probably made up of large estuaries leading to the open Gulf.

The peninsular area consists of fertile hilly country with relatively high relief, particularly in the central area around modern Junagadh. The exterior coast is exposed to the Indian Ocean along its entire length, except for the relatively protected bay at Porbandar and the portion of the coast protected by the island of Diu. Gupta's study (1977b:181) has shown that the ancient coast featured numerous coral reefs and shallow beaches, but little is known regarding the species of shell found in these exposed marine benches. Modern shell distributions along this coast indicate that although isolated examples of the major gastropods do occur, they come from deeper waters and are inaccessible to divers due to dangerous currents. It is possible that during the 3rd millennium B.C. a similar

distribution occured along this coast, suggesting that it was not a major source area for the large gastropods used in the Indus shell industry.

In the Gulf of Khambhat, however, the present situation does not necessarily reflect the ancient habitat. At present, the Gulf is polluted by sediments being brought down by numerous peninsular and continental rivers, and this situation has probably led to the obliteration of any major shell beds in this region. The presence of rocky islands and submerged reefs, suggests that prior to this heavy silting, the habitat may have been suitable for the development of large populations of the major gastropods, and the coastal sites such as Lothal and Somnath may have gotten their raw materials from the Gulf of Khambhat rather than from the Gulf of Kutch.

On the mainland east of Khambhat, are the plains of Gujarat, watered by the Narmada and Tapti Rivers. Further east is the Malwa and Deccan Plateau, while to the north the Aravalli mountains extend as far as the Ganga-Jamuna plain near Delhi. These mountains form a dividing line between the Thar Desert on the west and the better watered regions to the east (Allchin, _et_ _al_.,1978:9).

Peripheral Regions

The maximum geographical extension of the Indus Civilization is difficult to define, primarily because of limited research in the "border" regions, but also because

there are no major cultural traditions bordering the Indus Civilization that demonstrate an abrubt change in material culture. Peripheral regions are those areas where we find an overlapping of specific cultural traits between the Indus Civilization and various semi-nomadic or isolated farming communities. One major peripheral region occurs in the Baluchistan Mountains west and north of the Sindhu/Nara plain. Here we have narrow valleys and high passes, leading to the highland plateau of eastern Iran and the river valleys of Central Asia. Shaffer (1978:7-13) has divided the region of Baluchistan into four major regions on the basis of ecological and geomorphological factors (after Raikes,1968). In the north, the Duki subregion borders the upper Indus plain and represents an important transitional zone between the semitropical Indus Valley and the semiarid Iranian Plateau. The major feature is the Thal alluvial plain watered by the Anambar River, which eventually flows into the Kacchi plain. Another important valley is the Loralai Valley, leading up to the higher plateau of the Sarawan sub-region. South of the Duki sub-region is the Jhalawan sub-region, where numerous small rivers cut through rugged hills, forming narrow alluvial valleys. The Nal river flows to the south and eventually reaches the Makran coast, while other smaller valleys cut through the Kirthar range and divulge directly into the Lower Indus plain. The Makran sub-region extends along the coast as far as the Dasht River and its alluvial plain. The upper reaches of

the Dasht River are connected by rugged passes with the Panjgur Basin to the north and the Nal Valley to the east. All three of these sub-regions are connected through similar passes or high desert plateaus with the Sarawan sub-region, a high plateau extending to eastern Iran and Central Asia. The major passes from the Indus Valley are the Bolan Pass in the south and the Gomal and Khyber passes to the north. The Quetta valley is further connected with the Helmand and Kandahar valleys by the Khojak Pass, and all three of these valleys open out into the dry deserts bordering the inland basin of Seistan. This entire Sarawan sub region has long been a crossroads between Central Asia and Turkmenia, Eastern Iran, the Makran coast and the entire Sindhu/Nara plain.

Another peripheral region is seen to the east of the Nara Nadi, in the Rajasthan Desert and in the Yamuna-Ganga Doab. The Doab is the fertile alluvial plain between these two rivers, and there is evidence for contact with indigeneous settlements during the Indus period, particularly in the Mature and Late phases (Joshi,J.P.,1981; Dikshit,K.N.;1981). Recent surveys in the desert regions of Cholistan (Mughal,1980) and Rajasthan (Hegde.K.;1976), have shown evidence for contacts extending into this dry but geologically rich area.

In the southeast, the peripheral regions are comprised of isolated valleys and rugged hilly areas in the Aravalli mountains and the Deccan Plateau. Here we see contact

between hunter-gatherer groups and the more established agricultural comunities on the alluvial plains (Possehl,1976). Even further southeast, the reported discovery of Indus script and diagnostic pottery from the site of Daimabad on the Godavari River (Sali,1977-78) suggests that, as at Shortugai in Northern Afghanistan, entrepreneurs of the major Indus cultural tradition may have penetrated to this distant region. One additional region must now be considered when discussing the peripheral extensions of the Indus civilization, and this is the coast of Oman. The recent discovery of a painted sherd with Indus script at the site of Ras Al Junayz indicates that some contact was made between groups living along the Indus coastal region and the Oman coast (Tosi,1982). This coast has numerous rocky islands where certain important gastropod species occur, and inland there are vast deposits of copper ore, both of which were important commodities for specialized industries in the Indus period sites.

In summary, the largest area of the Indus Civilization is made up of the vast drainage system of the Sindhu/Nara plain. Two additional regions are seen, one to the west along the Makran coast, and the other to the east, including the regions of Kutch, Kathiawar and the plains of Gujarat. Peripheral extensions are noted in isolated sites in Northern Afghanistan, Central India and possibly even the coast of Oman.

The identification of sites possessing characteristic features of the Indus Civilization in these peripheral regions, brings us to the often discussed question of what makes a site "Indus / Harappan" ? I do not presume to be able to answer this question completely, but the purpose of this study is to present new data regarding one aspect of the Indus Civilization, the shell industry, that will help in identifying additional features that can be definitely related to the major traditions characteristic of this vast culture. In the next section we will briefly look at the major characteristics of this civilization in order to provide a background for the discussion of the shell industry.

General State of Research

Our present knowledge of the Indus Civilization is based primarily on interpretations of material culture excavated from major urban and rural settlements in the Sindhu/Nara region (Greater Indus Valley) and its adjacent regions. With the excavation of new sites, and the reanalysis of previously excavated materials, significant new interpretations have been put forth, so that over the past 50 years our understanding has slowly changed and continues to develop as new questions are being asked. The earlier interpretations (Marshall,1931; Mackay,1938; Piggot,1965?; Wheeler,1968, etc) provided the basic foundation for much of what is now considered standard

knowledge about the general character of the Civilization.

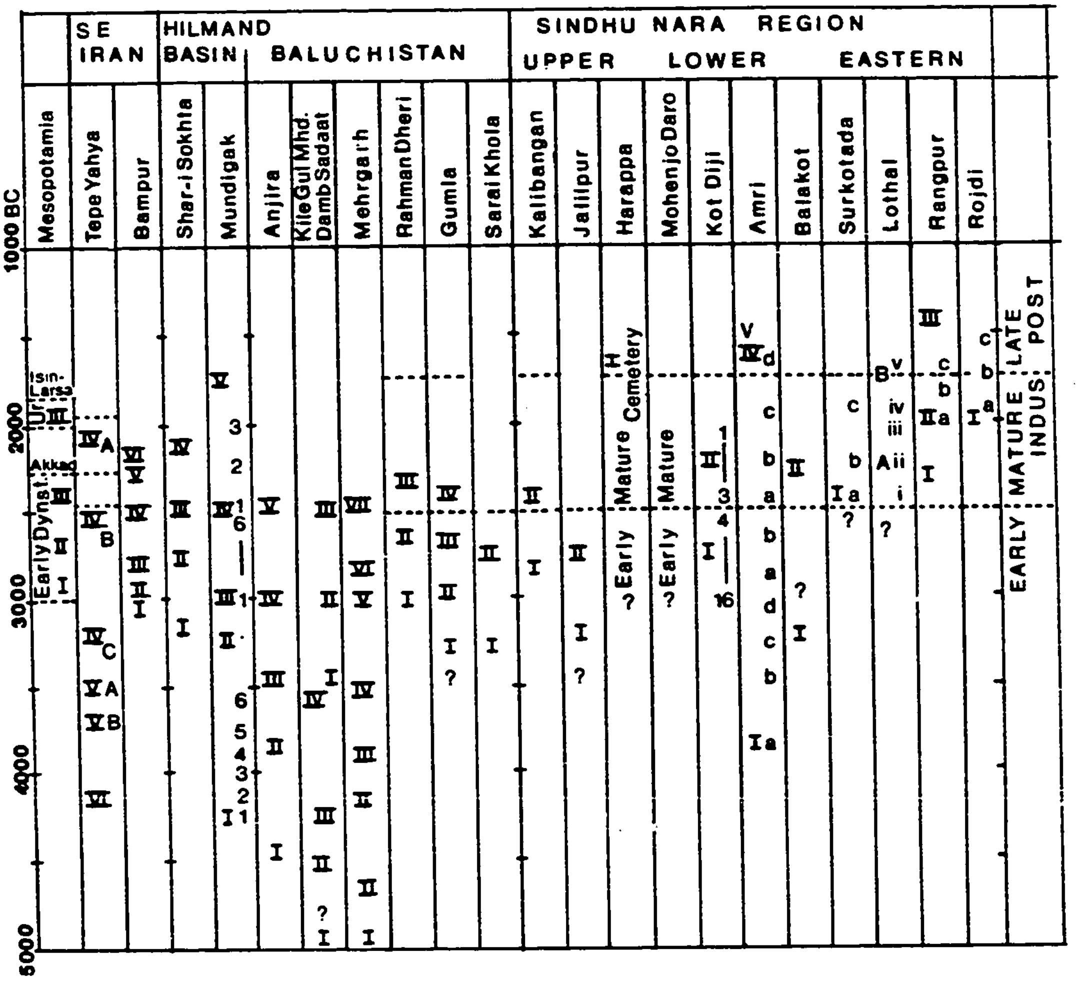
The Indus Civilization was a complex urban society that was characterised by large cities that were connected by various internal trade/exchange networks to rural agricultural and coastal settlements and distant resource areas. External trade/exchange contacts demonstrate cultural and economic interaction with contemporaneous urban centers in the Gulf region and West Asia. Indus cities were built on a gridiron pattern with blocks of architecture oriented in the cardinal directions, connected by major north/south and east/west running streets. City planning included the provision of private and public wells and sanitary covered drains leading out of the habitation areas. Most large cities were divided into two major sections, a lower city on the east and a higher but smaller area on the west. Both of these sections had habitational units, industrial units and large public buildings. At Harappa and several other sites there is evidence for a fortification around the higher mound, leading to the use of the term "citadel mound". The use of this term at Mohenjo Daro is based on the occurrence of massive structures excavated by Wheeler on the eastern face of the mound (Wheeler,1968). Numerous interpretations have been put forth regarding the socio-economic, administrative and religious function of this upper city, but as of yet there is no concensus of opinion.

These larger cities are all located on important river

systems that formed a part of the major access routes connecting the different regions and peripheral resource areas. Numerous smaller sites have been discovered along these routes and in the various resource areas, and are associated with these larger urban centers on the basis of similarities in material culture. The most important features include a standardized system of weights and measures, similar pottery types, figurines, ornaments, a fairly uniform copper/bronze technology, the widespread use of chert blade tools made from Rohri chert, and most important of all, the use of carved and inscribed seals having a standardized script. Any site having one or more of these attributes is generally ascribed as belonging to the Indus Civilization, but this has led to considerable confusion when dealing with the peripheral regions, where local features are dominant and the so called "Harappan" or Indus features are minimal. These and other problems regarding the development of this civilization have led to numerous discussions and a radical change in methodology (Dyson,1982). Excavations at smaller rural sites, the reanalysis of primary data and further excavations at the major sites have shown that this civilization developed out of regional agricultural and semi-nomadic pastoral groups living in the Sindhu/Nara Plain and the transitional zone of Baluchistan to the west. The early ideas about the introduction of the idea of civilization from already established western cultures has been discarded or modified

in the face of new evidence for the indigenous regional development of domestication plants and animals, sedentary life and urban planning prior to the Indus Civilization (Fairservis,1967; Jarrige and Meadow, 1980). Furthermore, the misconception of a uniform society with monotonous styles and mass production need hardly be discussed in view of the recent studies of regional variation at specific sites, and variation within the major site of Mohenjo Daro (Dales and Kenoyer, in press; Dales and Kenoyer,1977; Kenoyer,1983; Shaffer,1982; Fentress,1979; Flam,1982;etc) Basically we see a shift from interpretations made from the perspective of West Asian cultures to a more indigeneous view from within the subcontinent itself. With this change in approach, concepts such as "cultural origins and cultural diffusion", have gradually been replaced with complex paradigms incorporating various levels of ecological adaptation and regional interaction.

TABLE 1-1. RELATIVE CHRONOLOGY OF IMPORTANT SITES OF THE INDUS VALLEY AND ADJACENT REGIONS.



Chronology and Definitions

Two radically different methods have been used to date the Indus Civilization and these provide us with a fairly reliable chronology for the early formative stage and the mature urban phase of this culture (Table 1-1). Although there has been considerable discussion regarding the definitions of these two phases, the Early Indus phase is represented by cultural deposits immediately preceeding the development of major urban centers throughout the Sindhu/Nara plain (Dales,1973:162). Mughal (1970) and others have demonstrated that the Early Indus (Harappan) period is represented by several regional cultures, the most important being the Kot Diji culture. This culture was common in the regions of Northern Baluchistan, the Upper Sindhu/Nara plain and as far south in the Lower Plain as the type site of Kot Diji. Certain aspects of the material culture, such as painted motifs on pottery, pottery types, figurines, architecture, etc. have a continuity with the later Mature phase. The Early Indus Phase as represented by the Kot Diji Culture is dated from around 3200 B.C. to 2500 B.C. on the basis of carbon 14 dates from Kot Diji and relative chronological comparison with other dated sites (Dales,1973; Mughal,1975).

Another regional aspect of the Early Indus phase is seen in the early levels at the site of Amri, numerous sites in southern Baluchistan and in the Kirthar/Kohistan regions. Similarities in material culture and certain architectural

features, such as the "acro-sanctum" (Flam,1982) continue into the mature urban phase, contributing to the development of the the classic division between an upper and lower city. The Amrian culture is dated from around 3600 B.C. to 3200 B.C. on the basis of C14 and relative dating methods (Casal,1961;Dales,1973; Mughal,1975).

In the northwestern area of the Sindhu/Nara plain we see another regional aspect of the Early Indus phase represented by the Sothi culture at Kalibangan and numerous other sites along the now dry tributaries of the ancient Nara Nadi. As with the Kot Diji and Amri cultures, this one also demonstrates a formative contribution to the later urban civilization, and is dated to around 2800 B.C. to 2400 B.C (Thapar,1967; Possehl, ed.,1979).

Together these three major regional developments resulted in the synthesis represented by what has been described as the Mature period of the Indus Civilization (Fairservis,1967; Mughal,1970; Dales,1973; etc.). This period is dated from 2500 B.C. to about 1750 B.C. on the basis of C14 dates from all the major sites, and by numerous correlations with dated sites in West Asia, Mesopotamia and Baluchistan (Dales, 1973; Meadow,1973; Mughal,1975; Shaffer,1978a; Shaffer, in press). The external correlations are based on the occurrence of diagnostic artifacts such as sealsi, ceramics and various types of beads that were traded from one region to the other. There is some controversy about the internal chronology of the

Mature Indus period itself, but this puzzle will only be solved when comparative stratigraphic analyses of regional sites has been carried out. Consequently, in this study we will be discussing the shell industry of the Mature Indus period in terms of a long chronological tradition.

Previous Studies

As was mentioned above, extremely rewarding studies ha e been carried out on some aspects of prehistoric technology and craft specialization. Mackay has presented a remarkable report on the bead manufacturing workshop at Chanhu Daro (1943), and Bannerjee (1959) and Sankalia (1970) have compiled important information regarding bead manufacture and lithic manufacture. The last two studies were based on non-Harappan materials, but they serve to provide general guidelines for future ethno-archaeological and technological studies in South Asia.

The most significant advances in technological studies have been made on materials from Iranian sites. Tosi and Piperno (1973) have made a detailed study of the lapis lazuli bead industry at Shar-i Sokhta that has provided interesting new perspectives on trade/exchange during the3rd millennium B.C. in Afghanistan and Iran. This study was complimented by a separate analysis and reconstruction of the manufacture and trade of chlorite vessels from Tepe Yahya (Kohl,1975b; Lamberg-Karlovsky;1975). As a result of these studies numerous interpretations have been proposed

for the rise of trade networks and specialized productiom in Southwest Asia (Lamberg-Karlovsky and Tosi,1973; Lamberk-Karlovsky, 1975; Kohl,1975a and b; etc). Kohl sees the third millennium trade in finished objects between Southwestern Iran and Mesopotamia as a result of surplus production of certain staple commodities in the richer agricultural region of Mesopotamia (Kohl,1975a;48). This surplus was exchanged for finished luxury items that were produced in outlying resource areas. Increased demand for these goods resulted in more specialization of their production and led to more complex internal social structures within these highland communities. The end result is seen in the dependence of these communities on Mesopotamian trade for providing staple commodities that they had formerly produced themselves (*Ibid*.) Other studies in the region of central Afghanistan and Eastern Iran have shown how the location and long habitation of sites such as Mundigak and Shahr-i Sokhta are directly related to the exploitation of different types of natural resources for trade/exchange (Jarrige,J.-F. and M Tosi,1979:123).

Very little research has been done on the shell industry of the Indus Civilization, the first detailed study of shell manufacturing techniques and stylistic features being conducted by me in 1975-76, at Balakot, Pakistan (Dales and Kenoyer,1977). In this study I was able to reconstruct the ancient manufacturing process for making bangles from the large bivalve, *Tivela damaoides* (formerly

referred to as *Meretrix casta*, see Chapter II for discussion). This analysis demonstrated the presence of two radically different technological traditions , using different species to produce a similar product (Chapter III,Balakot). The coastal site of Allahadino has also provided an interesting collection of shell artifacts, and a small sample of these has been studied by Priscilla Turnbull at the Field Museum of Natural History in Chicago (Turnbull,1982; pers. comm.).

At most of sites of the Indus Civilization, the excavators have recorded the presence of shell artifacts and manufacturing debris, but there has been very little interest in the nature of this industry. Mackay (in Marshall,1931:562-588) briefly described the modern bangle cutting techniques used in Bengal and suggested that the same techniques were probably used at Mohenjo Daro. Most subsequent excavation reports have done little more than refer to this general and incomplete description. The identification of shell species found at Mohenjo Daro and Harappa were based on small selected samples of complete shells and therefore not representative of the wide range of species actually found at the site. Furthermore, some of the earlier identifications (Sewell and Guha,1931; Prashad,1936). need to be revised because of later changes in nomenclature (see Chapter II).

There have been some important studies made of the shell artifacts from West Asian sites,(Durante,1975,1978),

and these have provided important comparative materials for my study. Durante has identified numerous different shell species from 3rd millennium sites in West Asia, and provided some general discussions of the different socio-economic implications of different types of shell artifacts. His study of shell manufacturing and utilization at Shar-i Sokhta (1975) and the comparative study of shell artifacts from Tepe Yahya, Shar-i Sokhta and Balakot (1978) are not quite as detailed as my own research, and some of his interpretations and identifications need to be revised. These same discrepancies are seen in his most recent report on the archaeological uses of shell in West Asia during the 4th and 3rd millennium B.C.(Tosi,*et al.*;1981). However, this report is quite comprehensive and provides much interesting new information that has been extremely useful for comparing the Mature Indus industry with that found in contemporaneous western cultures.

In terms of ethnographic data, there are several valuable studies on the modern, or rather traditional, shell working industries in Eastern India and Bangladesh. James Hornell made a comprehensive study on the commercial and ritual uses of the "sacred conch shell", *Turbinella pyrum*, L.(1915). The detail with which he studied all of the numerous customs and traditions surrounding this shell is phenomenal, and it is unfortunate that the sites of Mohenjo Daro and Harappa had not been recognised when he was compiling his data. More recently, a detailed monograph was

published on conch products in West Bengal, where many interesting socio-economic and technological aspects of the industry are discussed (Sen and Sinha,1961). Although both of these earlier studies have provided invaluable ethnographic data on the traditional shell industry, neither of them was conducted with archaeological problems in mind. For example, what types of manufacturing waste result from different production stages? How are waste materials reused or discarded within the site ? What kinds of distributions and percentages of raw materials and finished objects are found in manufacturing areas, as opposed to habitational areas? These are only a few of the important questions that can be answered in the ethnographic situation, and these answers can help in our interpretation of the archaeological record.

In summary, there have been very few systematic, problem oriented studies of the archaeologcial shell materials or the ethnographic shell industries. Durante's perspective was in terms of international trade and general characteristics of the industry, while my own study from Balakot was on specific stylistic and technological features of the industry at one site. Now it is necessary to go further and present a comprehensive view of the shell industry as it developed and spread throughout the Sindhu/Nara plain and adjacent regions.

CHAPTER II. CLASSIFICATION AND DESCRIPTION OF MOLLUSCA.

Nomenclature and Description.

Before any discussion of shell artifacts can begin, it is imperative that the terminologies used in the description, identificaton and classification of mollusca are well understood. In the following chapter I have first outlined the important system of classification and nomenclature used in the identification of molluscs. Then I have attempted to sort out the often times confusing names and present a comprehensive list of the different marine, terrestrial, and fresh water species of mollusca found in excavations of Indus Period sites. Special attention has been paid to those species whose shells were used as raw materials in the manufacture of ornaments or utilitarian objects. The major species of mollusca used as raw materials will be described in detail because of important differences in their morphological structure, geographical distributions and their use as raw materials.

The classification of Mollusca is based on the Linnaean taxonomic system that uses a hierarchy of seven basic categories to classify living organisms; KINGDOM, PHYLUM, CLASS, ORDER, GENUS, and SPECIES. These seven basic categories can be expanded by adding the prefixes 'sub-' or 'super-', and even further distinctions can be made by

defining variants or ecotypes. This system of classification is a valuable tool for grouping and describing organisms on the basis of their genetic or morphological similarities, but due to the fact that there are over 250,000 generic names for Mollusca and over 2 million species names (Solem,1974:5), there is unavoidable duplication and confusion regarding the accepted scientific nomenclature for certain organisms. Inconsistencies in nomenclature among malacologists and conchologists has unfortunately resulted in the propagation of misnomers and incorrect identifications by unsuspecting archaeologists and historians. The order in which I have presented the major species used as raw materials is based on their importance as a raw material and does not necessarily follow the ordering used by conchologists. The nomenclature used in this dissertation conforms with the generally accepted nomenclature used to describe Indo-Pacific mollusca, and I have relied heavily on the classifications presented by Kathleen Smythe in her recent book on the Seashells of the Arabian Gulf(1982)[1] and Sally Kaicher's earlier work on Indo-Pacific Sea Shells(1956-57). Whenever there has been a controversy over the identification of a particular species I have resorted to the more comprehensive study , Indo-Pacific Mollusca edited by R.T.Abbott (1959-1976),as well as tracing down the original sources in which a questionable name was proposed. In some instances it has been beyond my expertise to determine the most acceptable

identification, and in such cases I have referred to the opinions of the International Commission on Zoological Nomenclature which is considered to be the final authority for nomenclature.

The name given to a particular shell has two parts, the Generic name and the specific name. Following these, the original author of the specific name is listed, along with the date when the name was published, for example; Voluta pyrum Linnaeus,1767. Often the Generic name is later changed, as was done with this species; from Voluta to Turbinella Lamarck,1799. In order to indicate that the Generic name has been changed, the specific author's name and date is placed in parentheses, e.g. Turbinella pyrum (Linnaeus,1767). Sometimes a name will have three parts, the Generic name, the Sub-generic name and the specific name, e.g. Chicoreus (Chicoreus) ramosus, (Linnaeus,1758). Another trinomial form occurs when subspecies are identified, e.g. Lambis truncata sebae (Kiener,1843), where the first name is the Generic one, the second is the specific name and the third is the subspecific name.

Within the Phylum: MOLLUSCA, there are seven CLASSES, three of which are commonly represented in the archaeological record. The largest class is GASTROPODA or UNIVALVIA, organisms that usually have a calcareous exo-skeleton, more commonly referred to as a shell. These organisms generally have a simple, coiled shell and are

found in marine, fresh water and terrestrial habitats. The next largest group, PELECYPODA or BIVALVIA, have a shell comprised of two halves or valves, and they occur in both fresh water and marine environments. The third class is SCAPHOPODA, organisms having a hollow tubular shell which looks something like a tusk that is open at both ends. Only about 350 living species are recorded for this class, and all are marine dwelling (Solem, 1974:24). Other classes that are not represented in the archaeological record at Indus period sites are the MONOPLACOPHORA, or segmented limpets ; the AMPHINEURA, including chitons, and the worm-like solenogasters; and the CEPHALOPODA, which include squid, octopus and the chambered nautilus. The nautilus is one of the few species that has an attractive shell that can be used for ornamental or utilitarian purposes, but specimens have not been identified yet from Indus sites.

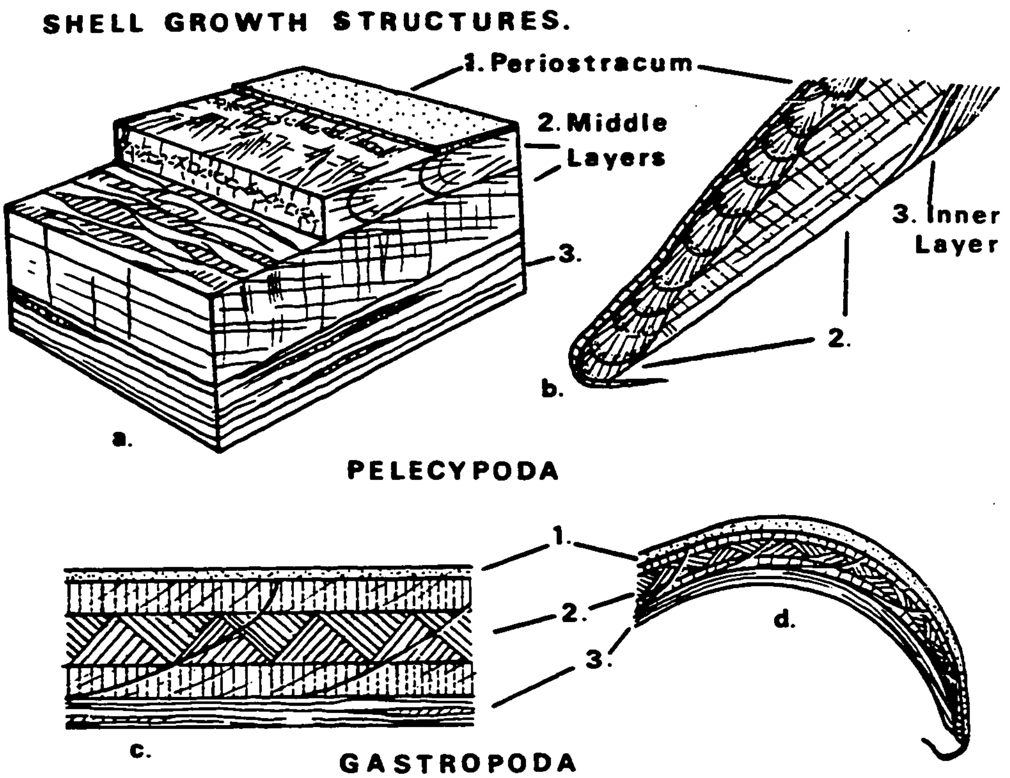
The archaeological importance of mollusca is due to the durability of their shells, which consist primarily of calcium carbonate crystals, in the form of calcite or aragonite, set in a "chitinous" matrix. The calcium that goes into the shell is obtained from sea water or from the plants and organisms that the mollusc eats (Morton,1967:28). Sea water is generally very rich in calcium, so that most marine shells are more massive than fresh water or terrestrial shells, where calcium may be deficient. The carbonate is obtained from the bicarbonate, $CO2$, or $HCO3$

,that is present in the mantle or general body tissues of the organism (Ibid.,p.29). Other minerals found in sea water are often brought to the sea by rivers and are incorporated in the shell. These elements can sometimes be isolated as trace elements, representing the catchment area of the rivers that empty into the sea near where the mollusc lives. Theoretically, identical species living in coasts with geologically different catchment areas, could be differentiated on the basis of their trace element fingerprints. These trace elements can also represents widespread changes in vegetation and land use patterns, such as deforestation, increased agriculture through irrigation, etc. Another feature of a shell's chemical composition is the presence of different percentages of oxygen isotopes in each growth layer. In some cases it is possible to estimate the temperature of the water in which a mollusca lived, and if large samples are available, even seasonal variations in water temperature can be obtained (Shackleton, 1970:409-410). For purposes of radiometric dating, the carbon of a shell is also very important. This can be obtained from the calcium carbonate of the shell by the action of acid, or by isolating the organic residue in the conchiolin (Shackleton,1970:412).

The shell of a mollusc can be divided into three general zones,(Fig.2-1) 1) an outer organic layer called the periostracum, 2) a prismatic or columnar crystalline layer made up of calcite and/or aragonite, and 3) an inner layer,

sometimes nacreous, formed of thin, laminated crystalline sheets (Morton,1967:28). The periostracum is a nerveless covering made of conchyolin or quinone-tanned protein (Ibid.) that shields the calcareous shell from acids, changes in salinity or temperature and especially from the attacks of decalcifying worms or sponges. The second zone is often quite complex and its microscopic crystalline structure varies considerably from family to family. However, within a single family or a group of related families, there is a basic uniformity in the shell structure (Trueman,1942:70 , after Carpenter,1844:15), and all molluscs produce their shell with a specialized organ called the mantle. This organ arranges calcite (specific gravity=2.7) or aragonite (specific gravity=2.9) in an organic matrix and joins layer after layer in varied crystalline structures to form the protective shell. The third or inner layer is comprised of extremely fine, almost homogeneous, prismatic layers that are irregular in thickness , but effectively cover most of the inner surfaces of the shell .

FIGURE 2-1. SHELL GROWTH STRUCTURE



a)Diagramatic view of growth layers of the clam (Tellina tenuis).

b)Cross section ventral margin.(After Trueman,1942)

c)Diagramatic view of a gastropod shell.

d)Cross section of a gastropod shell.(After Woodward,1890)

A shell's durability and hardness is dependent upon the chemical composition and crystalline structure of the various growth layers. Boggild (1930:245) defines seven different types of shell structure based on variations in the arrangement and size of the crystalline layers; homogeneous, prismatic, foliated, nacreous, grained, crossed lamellar and complex structures. In fresh water unionid clams and land snails this zone is comprised primarily of crossed lamellae of aragonite. Being less stable than calcite, these laminated sheets of aragonite are quite fragile and tend to flake apart along the cyclical growth layers. Some marine genera , such as Nerita,Haliotis,and Patella have alternate layers of both calcite and aragonite (Solem,1974:10). These shells are more durable than those of fresh water or terrestrial types. A detailed study of bivalve shell structure by Trueman (1942:69-92) has shown that in many bivalves, the second zone is made up of a double layer , the inner being of crossed lamellar structure and the outer of radial prisms. (Fig.2-1;a,b) Species having this peculiar structure include Tellinidae, Lucinidae and Donacidae,all of which have relatively thin shells. This double layer provides for a much stronger shell. In other families,particularly the Veneridae and Mactridae, the second layer consists of only one zone of either crossed lamellar structures or radial prisms. These species are much more massive than those mentioned above, and the extreme thickness of the second zone supported by a thick inner

layer provides for a sturdy, durable shell.

The hardest and most complex crystalline structure is seen in the shells of certain gastropods, and consists of three strata composed of groups of parallel plates arranged longitudinally or at right angles (Woodward,1890:34). (Fig.2-1;c,d) In some genera (i.e.Cypraea), the outer and inner layers are arranged longitudinally while the middle layer is made up of plates set transversely , at right angles. (Fig.2-1;a,b) In other genera (i.e.Oliva, Voluta, Turbinella) the arrangement is reversed. The complex structure of the different strata result in a sturdy, shock resistant shell that can withstand the incessant pounding of the waves or the attacks of fishes or crabs. Hardness, however, is relative to the stability and preservation of the original crystalline structure of the shell. Boggild (1930:254) notes that "...an aggregation of fine elements, especially fine threads intimately mixed, is much stronger than a larger crystal of the same kind." A fresh Turbinella pyrum shell is between 5 and 6 on the Moh's scale of hardness (Brinell's 137 and 147), and it will retain this hardness indefinitely so long as there is no decalcification and breakdown of the crystalline structure. Generally this occurs from contact with acid. In the archaeological context, shells excavated from highly acidic soils are usually heavily decalcified, whereas those found in alkaline soils are generally fresh looking and extremely hard.

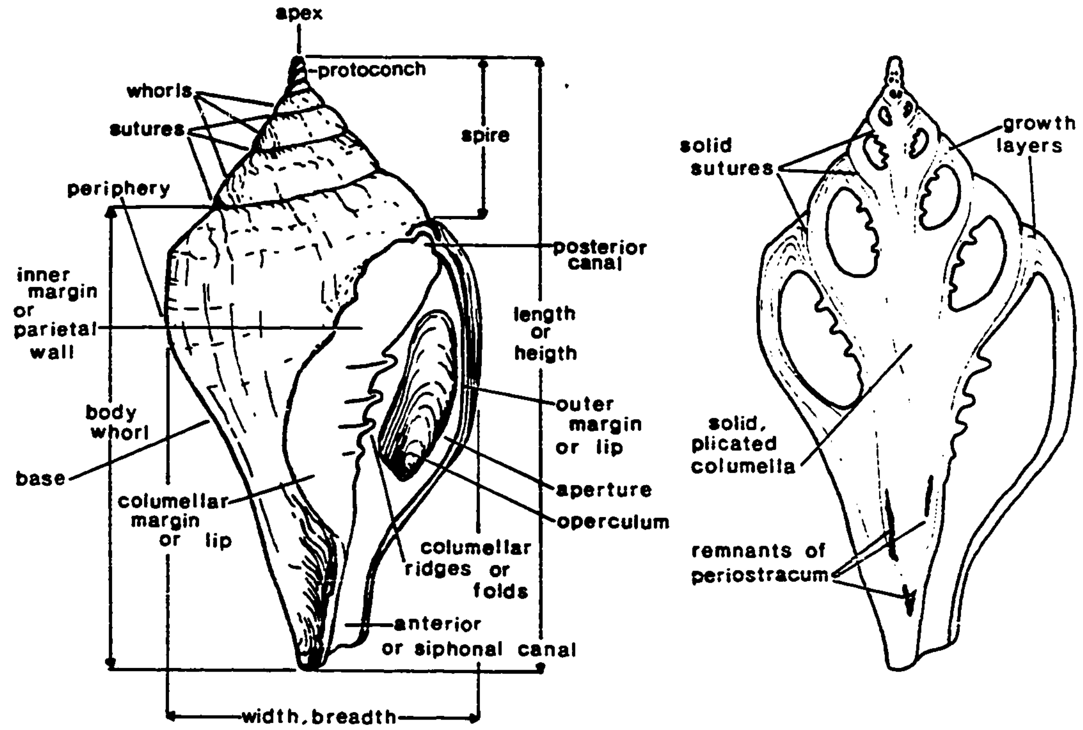
A mollusc builds up its shell in a gradual process that

continues throughout most of the year. During the winter months, or seasons of rest, this process slows down or ceases, and as a shell gets older, the cycles become less and less consistent (Berry, 1972:3-13). Many detailed studies have attempted to define the "rhythm" or cyclical growth patterns of molluscs, particularly of bivalves, in order to understand prehistoric environmental changes (Shackleton,1970) or human subsistence patterns (Coutts,1970). Unfortunately there is no conclusive evidence to demonstrate a high degree of consistency in these growth layers, because of the numerous variables that can effect the rate of deposition (Berry,1972:3-13). Abrupt changes in temperature due to violent storms, traumatic events such as being attacked by a fish, picked up by a strong current, or being stranded at low tide can all effect the rate at which growth layers are laid down (Ibid.). In isolated geographical areas, where seasonal fluctuations are represented in a large sample of a single species of bivalve, it has been possible to determine the approximate age of individuals or the general season (within three months) during which shells were collected (Coutts,1970: 874) However, in dealing with shells of different species, coming from differing geographical areas and from uncertain chronological periods this type of analysis has not yet been worked out.

The same variables that effect the rate of growth also effect the morphological structure of the shell and reflect

the type of environment where a species lives. Shells of the same species living in different environments, will show a range of variation in shape that reflects the differences in current, turbidity, water pressure, availability of food and the general favorability of the habitat. For example, the <u>Turbinella pyrum</u> living in an optimal habitat, with an abundance of food and a low degree of turbulence, show a well balanced growth of the spire and body whorl, while those living in shallower waters, in muddy conditions and and inadequate food supply, show a marked irregularities and stunting in growth (Hornell,1916:109-122). This type of variation in shell morphology within a single species living in overlapping geographical areas is not considered sufficient to define a sub-species, but is more commonly referred to as an ecotype.

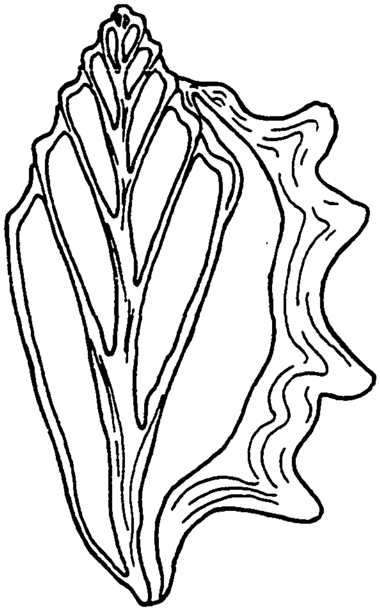
FIGURE 2-2. PARTS OF THE GASTROPOD SHELL.



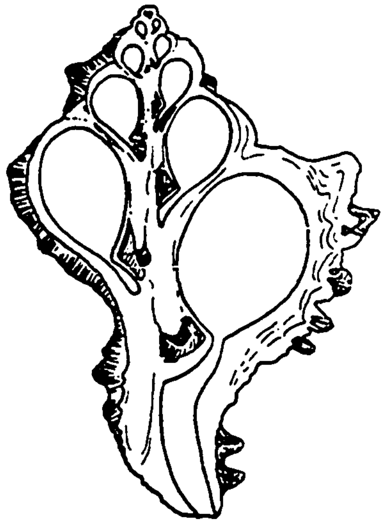
a. VENTRAL VIEW Turbinella pyrum L. SECTION

INTERNAL STRUCTURE OF OTHER LARGE GASTROPODA

b. Fasciolaria trapezium L.



C. Lambis truncata sebae Kiener



d. Chicoreus ramosus L.

Major Species used as Raw Materials

CLASS GASTROPODA

There are over 40,000 marine species, 24,000 land species and over 3,000 fresh water species of gastropods (Solem,1974:24). However, there aren't quite that many species in the coastal regions that were accessible to the ancient Indus peoples, and so far we have only found about 55 different species at various Indus sites. Most of these species were only slightly modified by perforating the apex or umbo, but the five large marine gastropods discussed below were used primarily for the production of other objects.

SUPER FAMILY VOLUTOIDEA
FAMILY TURBINELLIDAE Swainson,1840
(= Xancidae (Woodring,1928)
Genus *Turbinella* Lamarck,1799
Species *pyrum* Linnaeus,1767
Accepted Nomenclature: *Turbinella pyrum* (Linnaeus,1767)[2]
Synonymy: *Xancus pyrum* (Linnaeus,1767)

A considerable amount of research has been carried out on this species because of its modern commercial importance, and since this same species was also extremely popular as a raw material for making ornaments and other objects during the Indus Period it is important to understand the basic details of its physical structure and its habitat area.

The most widespread form of Turbinella pyrum has been described by Hornell (1915:1-7, 1916:114) as the variety "acuta" , because of its well balanced growth and its widespread distribution from the Gulf of Kutch to the Gulf of Mannar , and all along the southeast coast of the Indian sub-continent. This major form has two related ecotypes, referred to by Hornell as "globosa" and "comorinensis" , and two variants, "obtusa" and fusus(Sowerby).

The five different varieties distinguished by Hornell are characterized by his following key (Hornell,1916:110).

Spire elongate; Shell widely fusiform. Breadth in Length 1.75:2.0	Shoulder angular, prominent.	1)var. fusus Sowerby. 2)Profile of whorls in spire convex, var.acuta, 3)Profile of whorls in spire nearly straight, var. comorinensis.
Spire short; Shell either globose or top-shaped Breadth in Length less than 1.75	Spire moderately short, shell globose, periostracum rough and thick.	4)var. globosa.
	Spire very short, shell top-shaped, very wide at shoulder. Periostracum thin and little sculptured in small and medium sized shells.	5)var.obtusa, with two forms: a)typica, b)rapa (Gme.)

Winkworth (1939:345-347) has strongly criticized Hornell's nomenclature on the basis of priority, but without resolving the question he has simply added to the confusion, by using outdated nomenclature for ecotypes occurring in overlapping geographic regions. The only "variant" identified by Hornell that has a completely isolated distribution is the species Turbinella fusus Sowerby, which

is only found near the Andaman Islands in the Bay of Bengal. In conformity with Opinion 489 of the International Commission on Zoological Nomenclature (1957-58:157-178) the name Turbinella pyrum (T. pyrum) will be used to refer to the most widespread form, as defined by Hornell (op.cit.). Furthermore, it is more acceptable to discuss the ecotypes in terms of their morphological and geographical peculiarities without using the Latin names that were incorrectly given them by Hornell.

Physical Characteristics. (Fig.2-2)

The shell has a simple, spiraling structure that is distinctly fusiform or spindle shaped, with a well balanced spire (Hornell,1915:1). The mean apical angle is 77.8°, with a range from 62° to 91.5° (Ibid.,1916: 114), and the average breadth to length ratio is 1:1.83 for medium, sized adult specimens, about 60 mm in diameter. Among the important features of this species, are its extremely thick shell walls and its massive sutures, which are solidly joined together. It has a wide ,ovoid aperture that is prolonged anteriorly into a long ,deep canal , which lodges the siphon used for feeding. The outer lip and inner margin are covered with a thick porcellanous layer tinged with a pinkish color that can turn deep red on mature specimens from specific localities (Ibid.,1914:4). In juvenile specimens the body whorl has extremely variable chestnut colored surface markings, but these tend to fade with age(Ibid.:5). The columella is solid, plicated and massive,

with three or sometimes four strong ridges or folds to which the columellar retractor muscles are attached.(Fig.2-2) The exterior surface of the shell is relatively smooth, but the shoulder ridges have a double series of compressed nodes or tubercules. A thick horny periostracum covers the entire exterior surface and it is generally brown or greenish brown in color. On older specimens the periostracum tends to wear away, especially at the apex , providing an avenue of ingress for organisms such as the boring sponge Cliona (Ibid.:7). Many of these boring organisms live in and about coral reefs, and Hornell found that those shells living near these reefs were more riddled with holes than those living on isolated sandy bottoms. He also notes that "...beds which have not been fished for some years, contain great numbers of Cliona-burrowed shells, whereas on beds fished regularly the proportion of 'wormed' shells is so low as to be practically non-existent" (Ibid.). Various forms of vegetation also find foothold on the periostracum, which inadvertantly serve as a form of camouflage, making the shell appear as a rock covered with sea-weeds.

Although the sexes are separate, there is some confusion regarding the value of external morphological features in distinguishing between male and female shells. Generally speaking, females are thought to be larger than the average adult male, which reaches sexual maturity when it is between 57 mm to 60 mm in diameter (Sundaram:1974:61). Although Moses (1923:121) states that there is no sure method for

distinguishing the sexes on the basis of shell morphology, females generally have a very noticeable thickening of the outer lip and an overlapping of the inner margin onto the body whorl. Male specimens on the other hand, have a relatively thinner outer lip and little or no overlapping of the inner margin.

The breeding season in South Indian waters extends throughout the months of January to March, during which the female deposits fertile ova into a many chambered chitinous egg capsule that is fixed upright on the sandy sea floor , looking something like a twisted ram's horn (Hornell,1915:6). The young larvae eventually develop an external shell , or protoconch, and proceed to eat their way out of the chambers and disperse on the ocean floor (Ibid.). Very little research has been done on the breeding seasons for the Kathiawar or Karachi shell beds, but it is probable that they occur during the same general season as in South India, that is, before the onset of the southwest monsoon. More research needs to be done regarding the rate of growth, but Hornell suggests that where there is an abundant food supply, they can grow to about 80 mm in diameter within one year (Ibid.). Once an individual reaches the adult size, its rate of growth decreases so it is difficult to estimate the age of large specimens that can reach as much as 200 to 300 mm in length and 100 to 150 mm in diameter.

Habitat

Turbinella pyrum is a gregarious species and tends to

inhabit areas of the ocean floor forming distinct beds. These beds can occur in various habitats (divided into five categories[3]), basically consisting of fine, loose sand mixed with some mud and coarser detritus (Mahadevan and Nagappannayar,1974:118-119). It is possible for this species to exist on a coarser bottom or an a muddier bottom. but the prerequisite for survival is the presence of sufficient food, comprised primarily of tube-building polychaete worms (Hornell,1915:1). These worms require a sandy bottom with some silt, and can exist on shallow sandy beds between rocky areas, but they cannot survive and provide a consistent food supply in regions where the bottom is constantly shifting. This situation occurs along the west coast of southern India and the western coast of Kathiawar, where strong currents are continuously moving tons of sand and silt up and down the coast. Major river deltas are also very unstable regions due to the quantities of silt and mud being carried out to sea. Such regions of high turbidity are not favorable for T. pyrum, which requires clean, salty water to grow normally. Even on fairly protected coasts, where there are stable reefs and rocky areas, long established shell beds can become silted over or scoured by storm currents and other natural agencies. For example, the pearl oyster banks and T. pyrum beds that were mapped by Hornell in the early 1900's were recently resurveyed, showing significant recent changes. Consequently , some beds have been obliterated by silting ,

while in other new ones have developed (Jonklass,1970:919). Recent silting in the Gulf of Cambay may have resulted in the silting over of major shell beds, because from the archaeological and historical evidence, we know that there were major shell manufacturing centers in this region from the 3rd millennium B.C. to as late as the 18th century A.D. The modern shell fisheries are all located in regions that are not now threatened by strong currents or heavy silting.

Distribution

A clear understanding of the distribution of Turbinella pyrum along the coasts of the sub-continent is necessary in order to reconstruct the ancient distribution of this species. Due to the commercial importance of the conch and pearl fisheries in South India, the coastal fishing beds have been quite thoroughly mapped by the Marine Fisheries Department, government of India. These surveys have found that most of the T. pyrum beds lie in close proximity to the pearl oyster banks, which are fished up to 8 km from the shore (Nagappannayar and Mahadevan,1973:672-686). The density of the shell beds is greatest in the Bay of Mannar, along both the Madras and Sri Lankan coasts.(Fig.2-3) On the eastern side of the Pamban Strait, in Palk Bay, there are equally important beds, but from Point Calimere north to Madras, the density steadily decreases. the northernmost occurence of T. pyrum on the east coast is the mouth of the Godavari River, where Hornell reports "...a few shells, all marked by stunted growth -individuals living in an

unfavorable environment." (1915:3). The northeast coast of Sri Lanka has some important fisheries , especially around Trincomalee, and recent surveys have also noted the occurence of large beds of T. pyrum along the entire southern coast of the island (Jonklass,1970:919). On the southwest coast of India, there are large commercial fisheries all along the Kerala coast, particularly around Trivandrum, but Hornell states that no T. pyrum are to be found further north on the west coast until you reach the Gulf of Kutch (Hornell, 1915:3). In this context, Hornell must have been referring specifically to commercially viable beds, because the species is found on the west coast. Melville (1893:1-5) reports specimens from Bombay, and during my research in Bombay I was able to examine specimens collected from Kolaba Bay, south of Bombay (courtesy of Mr. A. Bhagat, personal collection). There is no question, however,that there is a low population density of this species on the western coast, and this same condition applies to the western coast of Kathiawar, as far as the Gulf of Kutch.

During my field research I received conflicting reports on the presence or absence of Turbinella pyrum from the Gulf of Khambhat and the coast of Saurashtra. I was able to confirm that occasional shells were still being collected off the coast near Somnath and that fishermen have caught shells in their nets when fishing in the Gulf of Khambhat. This information was provided by local fishermen and shell

merchants in Somnath, and I was able to examine specimens with their periostracum intact that were purported to have been fished locally. This information was further substantiated by M.I.Patel, Research Officer of the Gujarat Fisheries Aquatic Research Station at Sikka. Mr. Patel pointed out that T. pyrum was uncommon on the west coast of Saurashtra due to the strong currents that continuously sweep the shore, and that occasional shells collected in this region probably were washed up from beds occurring at greater depths.

In the Gulf of Kutch itself, there are relatively large populations scattered between the coral reefs and oyster banks, extending approximately 130 km along the southern shore (Nagappannayar and Mahadevan,1974:133). The northern half of the Gulf is much sandier with no reefs, with a tendency towards shifting underwater dunes. This type of unstable bottom is not suitable for the formation of shell beds and any coastal area subject to such conditions in the past could not have been a source for T. pyrum.

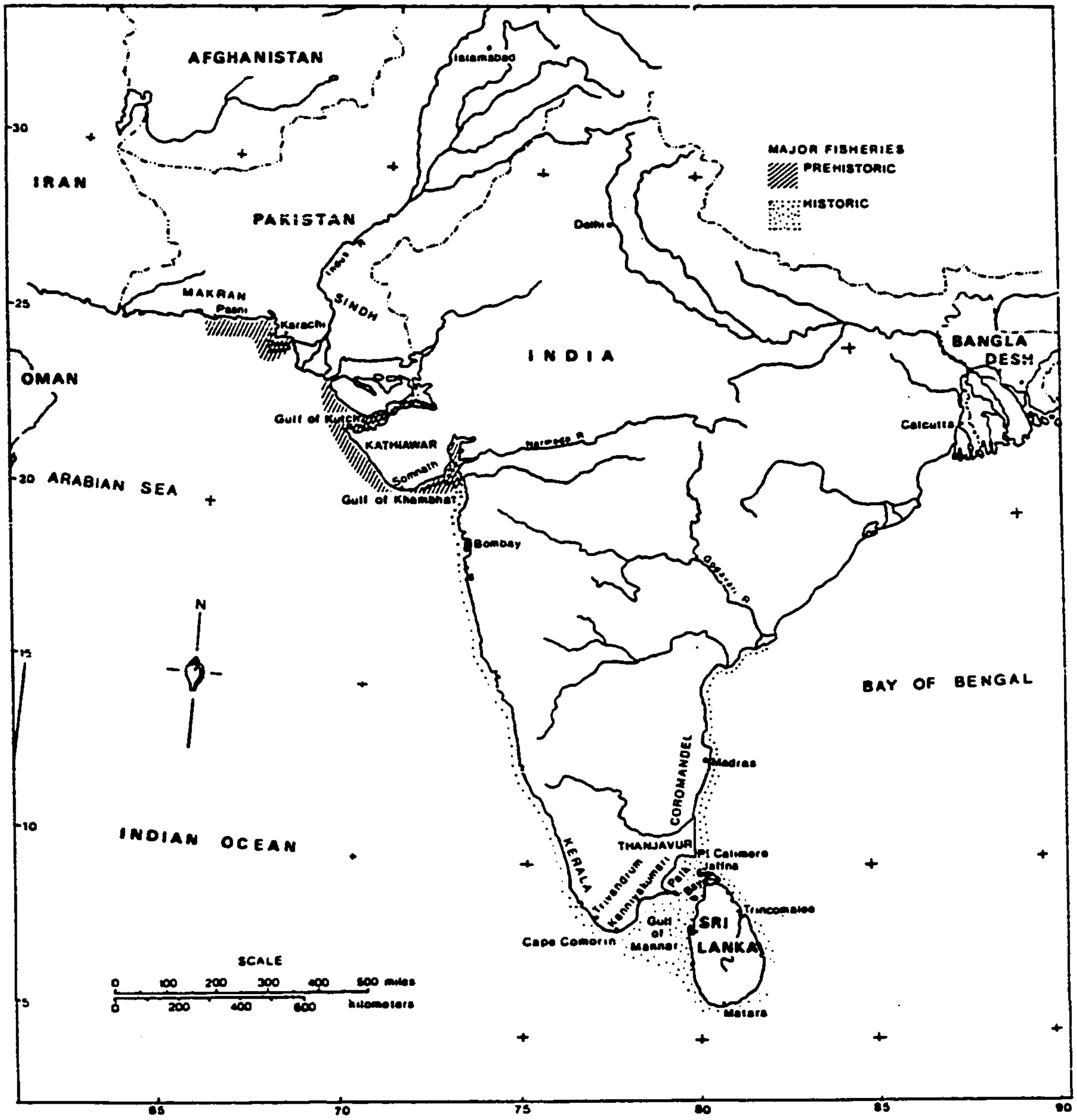
Proceeding further west along the coast of Sindh , the next concentration of T. pyrum occurs in the protected bays west of Karachi. The entire coast between the Gulf of Kutch and Karachi Bay has always been a very unsuitable habitat for this species due to the expansive delta of the Indus River. In Hawkes Bay , just west of Karachi there are large populations living on sandy bottoms between the submerged rocky ridges, ranging in depth from the sub-littoral zone to

about 10 meters (personal survey, Melville and Standen,1901:417). According to local fishermen, another important bed is located on the western side of Ras Mauri (Cape Monse), near the village of Bhit Kori. I have not been able to discover any specimens from either Gadani or Sonmiani Bay, to the west of Bhit , but there is a possibility that they occur in beds further out from the shore. This is suggested by the discovery of one live specimen from Pasni, about 275 km west of Ras Mauri (Khan and Dastagir,1971:56-57). Several sub-fossil shells have also been collected from Pasni by the Zoological Survey of Pakistan, and it is not unlikely that other beds will be found along the Makran coast. Beyond Pasni, however, the marine environment changes along the Iranian coast from the mouth of the Persian/Arabian Gulf. There is no evidence of the occurence of _T. pyrum_ in the Gulf region, and no surveys have recovered even sub-fossil specimens from this area (Smythe, 1982; Durante,pers.comm.;Tosi, _et al._,1981:25-26).

FIGURE 2-3. DISTRIBUTION OF TURBINELLA PYRUM.

Locality No.	Depth/Meters	Type of Bottom	Reference
1. Trivandrum	10-20	Sandy	Nagappannayar and Mahadevan 1974:124
2. Kanniyakumari	10-20	Sandy	"
3. Gulf of Mannar	10-20	Sandy	"
4. Palk Bay	up to 12	Sandy/Mud	"
5. Coromandal Coast	6 -20	Sandy/Mud	"
6. Sri Lanka NW Coast	3 -20	Sandy	Jonklass,1970: 920
7. Sri Lanka NE Coast	3 -20	Sandy	"
8. Jaffna Lagoon	up to 1.5	Sub-fossil	Nagappannayar and Mahadevan 1974:124
9. Gulf of Kutch	up to 10	Sandy/Mud	"
10.Buleji Hawkes Bay	up to 10	Sandy/Mud	Personal Survey
11.Bhit Kori	up to 10	Sandy/Mud	Local Fishermen
RARE OCCURANCES			
12.Pasni Makran Coast	sub-littoral	Sandy	Khan and Dastagir, 1971:56-57
13.Godavari River	?	Sand/Mud	Hornell,1915:3

FIGURE 2-3. DISTRIBUTION OF <u>TURBINELLA PYRUM</u>.



Description of Ecotypes

The *Turbinella pyrum* collected from the Pakistan coast and from the Gulf of Kutch are identical to the most common form found in the Gulf of Mannar and other fisheries of South India and Sri Lanka. Due to the fact that very little quantitative research has been carried out on the populations from the coast of Pakistan and the Gulf of Kutch, it is not yet possible to determine if there are any specific ecotypes in these regions. By doing detailed studies of shell morphology, Hornell was able to distinguish several variant forms occurring in different, but overlapping environments. The main characteristics of these forms have been given above, but it would be worthwhile to look at other details of their physical characteristics and distributions. The most important variant is a short-spired, inflated form that Hornell calls "*obtusa*", (Hornell,1916:113). It is in this variety, especially individuals from the Thanjavur coast, that the aperture attains a dark red coloring (Hornell,1915:7). The distribution of this form overlapps that of the more common form, but is generally restricted to regions north of the Pamban Pass, from Palk Bay to the Godavari River mouth. "This extreme form appears to arise when the environment is highly unfavorable, such as life in a muddy sea co-ordinated with scarcity of food"(Hornell,1915:5) It is this form that Linnaeus used when describing *Voluta pyrum*.

Two other varieties distinguished by Hornell, occur

along the eastern and western coasts of Cape Comorin. One ("comorinensis") has all the basic features of the most common form, except that the shoulder is more rounded and the profile of the whorls in the spire are almost straight, rather than convex. This ecotype is generally found in shallow water that is exposed to heavy swells (Hornell,1916:17). The other form ("globosa") has a shorter spire, similar to the inflated, globose form, but in addition it has a particularly rough and thick periostracum. It occurs in the same geographical area as the straight profiled ones, but at a greater depth, where it is not affected by the ocean swells (op.cit.). Although I have not had the opportunity to examine these various forms to the extent that Hornell did , it seems inconsistent with his reasoning that a short-spired, globose form, which he attributes to muddy environment and scarcity of food, would also develop in less turbid, deeper waters, where there is evidently sufficient food. It is obvious that a great many variables are involved in the structural development of each individual specimen, and more detailed studies must be made before defining any specific ecotypes. In addition to Hornell's three ecotypes, R. Jonklass (1970:919) mentions the discovery of what might be another form, having an extremely broad and heavy shell structure. It has been noted along the southern coast of Sri Lanka, between Matarra and the Great Basses. (Fig.2-3)

SUPERFAMILY MURICACEA

FAMILY MURICIDAE

Genus *Murex* Linnaeus,1758

Sub-genus *Chicoreus* de Montfort,1810

Species *ramosus* Linnaeus,1758

Accepted Nomenclature:

Chicoreus (*Chicoreus*) *ramosus* (Linnaeus,1758)

Synonymy: *Murex ramosus* ,Linnaeus,1758

Along with *T. pyrum*, this species was one of the more commonly used raw materials in the production of shell ornaments and utensils, particularly, ladles or spoons.

Physical Characteristics

Chicoreus ramosus is the largest species in this genus and attains a larger size than either *T. pyrum* or *Lambis truncata sebae*, however, its shell is not quites as massive as in these other species. Adult specimens range in size from 70 mm to 250 mm in length and 60 mm to 200 mm in breadth, including the varices. Varices are produced on the outer lip by a thickening of the shell wall before periods of rest in the growth cycle. In this species they are formed of characteristic sets of three graduated curving spines, each having rows of recurving spiny fronds (Rogers,1936: 27). A single incurved tooth-like spine occurs on the lower right hand margin of the outer lip, differentiating juveniles of this species from other smaller species of the same genus. This spine is partially eaten

off by an acidic secretion to allow for continued growth and a new set of varices are built up (Rogers,1936:28). The exterior of the shell is basically white, with occasional varied patterns in light brown , while the aperture is tinged with pink. If the varices are removed, one can see that the shape of the body whorl is fusiform , globose, and without the mass of spines the body walls are relatively thin. The columella is hollow and spiraling (Fig.2-2), but the sutures are quite strongly cemented. These various features make it unsuitable for making solid objects from the columella, but once the spines have been removed, it can be cut diagonally to produce large circlets for bangles. Although the flesh of this species is edible, it is not customarily eaten by any known population, and the shells are collected primarily for their ornamental value.

Habitat

In general they occur in the intertidal zone, especially in rocky or reef areas, to depths of over 20 meters. This species is carnivorous and crawls over large areas to locate its prey, which consists primarily of oysters or any slow moving mollusc (Rogers,1936:27). Although they are not gregarious, large numbers can be found together in habitats with sufficient food resources. Ironically enough, even though this species is equipped with decalcifying acids, its thin periostracum does not protect it from similar attacks from other predatory species, that also haunt the reefs. Consequently, most specimens have

numerous holes perforating the shell, and various calcareous accumulations.

Distribution

This species is said to have a wide distribution throughout the Indo-Pacific region, but its actual distribution along the coasts of the sub-continent is somewhat limited. It is common in the shallow bays of South India and Sri Lanka, and then again in the Gulf of Kutch. Along the Sindh and Makran coasts however, it is relatively uncommon , except around Fahal Island in the Gulf of Oman (Bosch and Bosch,1982:89). In the Arabian Gulf itself, Smythe suggests that this species may have only recently become extinct , based on the fact that she has seen remarkably well preserved specimens supposed to have come from this area (1982:59). This may in fact be the case, since others have reported the occurrence of this species from the Red Sea , a region of similar high salinity (Rogers, 1936:32).

SUPER FAMILY STROMBOIDEA

FAMILY STROMBIDAE

Genus *Lambis* Roding,1798

(=*Pterocera* Lamarck,1799)

Species *truncata* subspecies *sebae* Kiener,1843

Accepted Nomenclature: *Lambis truncata sebae* (Kiener,1843)

Synonymy: *Pterocera* (*Heptadactylus*) *sowerbyi* Morch,1872

Pterocera sebae "Valenciennes" Kiener,1843

There are three species of the genus *Lambis* occurring in the coastal waters of the Indian sub-continent, but the subspecies *sebae* appears to have been the most commonly collected as a raw material for making inlays, beads and solid animal figurines by the Indus peoples.

Physical Characteristics

This subspecies is quite large and massive, with adult specimens reaching from 200 mm to 300 mm in length and 130 mm to 200 mm in width, including the digitations (Abbott,1961:156) (Fig.2-2). The most conspicuous feature of this genus is the presence of 6 or 7 digitations , six of which protrude from the outer lip, and one that is an extension of the anterior canal. In *sebae*, these digitations are not very distinct due to massive build up of porcellaneous, enamel layers on the outer lip. The spire is well balanced, having a series of tubercles along the shoulder ridge adjacent to the suture. Between each suture, the profile is slightly concave, but the overall apical

angle ranges from 80° to 100°. (Ibid.). In this species the body whorl has a fairly regular curvature, without any of the humps or nodes common on other species of this genus. Juvenile specimens have a crenulated outer lip rather than digitations, but as the shell matures these digitations appear in the form of canals, which gradually fill in and become more extended with each added layer of enamel. The enamel accumulations are quite extensive along the posterior canal, and generally extend over the entire ventral half of the apical whorls. Although the columella is solid and spiraling , it is not nearly as massive as would be expected for a shell of this size. In fact, except for the heavy accumulations on the outer lip and the interior of the body whorl, the remainder of the shell walls are quite thin and the sutures are not well cemented.

The periostracum is thin and slightly translucent, barely protecting the exterior of the shell, which is cream colored with a light brown mottling. On older specimens, the exterior surface becomes covered with calcareous algae and honeycombed by burrowing organisms (Ibid.:155).

Habitat

This species is gregarious and lives in colonies on sandy or coral rubble bottoms adjacent to coral reefs. They tend to prefer the seaward side of the reefs and occur from the intertidal zone to about 10 meters (Ibid.:156), but occasional specimens are to be found on the reefs, or even

in shallow sandy areas with weeds. Very little is known of the feeding habits and breeding seasons of this subspecies, but they are probably similar to those of the related species Lambis lambis,L.(see below).

Distribution

The subspecies sebae has a peculiar distribution, being divided into two geographically distinct regions by another subspecies Lambis truncata truncata,Humphery (see below). It is found in the Red Sea, the Gulf of Oman (Bosch and Bosch, 1982: 61), in the Arabian Gulf and along the Makran coast to Karachi. Then on the eastern side of the Indus delta, it occurs in the Gulf of Kutch, but there don't appear to be any occurences along the southern coasts of the Indian sub-continent, and it is only found again on the east coast of Sumatra. From there,however, its distribution encompasses the entire Southwest Pacific region except for the Hawaiian Islands. Abbott suggests two possible reasons for this distribution pattern. "Either, two morphologically similar forms have evolved independently of one another, or the once continuous distribution has recently been broken by the intrusion of a geographically intervening race of flat topped India Ocean species",(Abbott,1961:156) namely the subspecies truncata. So far, no examples of the subspecies truncata have been discovered from sites of the Indus Civilization, but there is a possiblity that it might occur in contemporaneous sites in southern India. If this can be substantiated, then we can assume that the present ,

discontinuous distribution of _sebae_ had already been established by the 4th or 3rd millennium B.C.

Genus _Lambis_ Röding,1798

Species _truncata_ subspecies _truncata_ Humphery,1786

Accepted Nomenclature: _Lambis_ _truncata_ subspecies _truncata_ (Humphery,1786)

Synonymy: _Strombus_ _truncata_ Humphery,1786

Pterocera _truncata_ Lamarck,1822

Physical Characteristics

This subspecies is generally larger than _sebae_, with adult specimens reaching 250 mm to 450 mm in length and ranging between 150 mm and 225 mm in width (Abbott,1961:155). It is characterized by a truncate , flat apex consisting of 4 or 5 whorls. The remainder of the spire has about five whorls that have a series of tubercles along the edge of the suture, and the areas between the sutures is concave. On the body whorl itself, three prominent nodes are found, the dorsal one being the most pronounced. The remaining morphological features are basically identical with _sebae_.

Habitat

Generally occurs in colonies on sand and coral rubble bottoms up to 10 meters, but is also found on reefs and shallow weedy areas from the intertidal zone to about 5 meters (_Ibid_.)

Distribution

This subspecies is found from the East coast of Africa, Zanzibar, the Seyshelle and Maldive Islands, to the Gulf of Mannar, the Andaman Islands, and as far as the Cocos-Keeling Atolls, southwest of Sumatra. (Ibid.:154).

Genus Lambis Röding,1798

Species lambis Linnaeus,1758

Accepted Nomenclature: Lambis lambis (Linnaeus,1758)

Synonymy: Strombus lambis Linnaeus,1758
Lambis lambis Gmel., Röding,1798

Physical Characteristics

Lambis lambis is considerably smaller than either of the previously described subspecies, and it is characterized by its long, slender digitations. Mature specimens range from 180 mm to 200 mm in length and 90 mm to 100 mm in width. The digitations are quite irregular in shape and size, but are markedly longer in female specimens. As in the larger subspecies, the juveniles have only a crenulated outer lip, but mature individuals have seven distinct digitations, six of which extend from the outer lip and one that is an extension of the anterior canal. The spire is well balanced and relatively smooth at the apex, with only a slight concavity between the sutures and minor undulations instead of tubercles. On the body whorl, however, there are three or four raised nodules, the dorsal one being most

prominent, especially in females. Again, the columella is solid and spiraling, but quite thin, as are the body walls and sutures.(Fig.2-2) A thin, translucent periostracum covers the exterior of the shell, which varies in coloring from cream with brown flecks, to a mottling of purple-tan or blue-black. The aperture is of a pinkish tint, and on juvenile specimens, there is a distinct brown splotch on the upper section of the inner parietal wall (Abbott,1961:152-153).

Very little research has been done on the breeding habits of this species in the Indian Ocean, but studies in other regions have noted a strong sexual dimorphism, where males are 40 percent smaller than females. It is known that it is herbivorous and feeds only on fine red algae, but not on brown algae or eelgrass (Yonge,1932:260, in Abbott, 1961:152).

Habitat

Usually occurring in colonies on sandy or coral rubble bottoms near reefs, but in Palk Bay it is extremely abundant on shallow weedy bottoms from the intertidal zone to three meters in depth (Hornell,1951: 13-14). In the Gulf of Kutch, it is found on the sandy bottoms between the reefs, and occasionally on the reefs themselves.

Distribution

This is the most common species of this genus and is found throughout the Indo-Pacific region. It is common all

along the coasts of the India subcontinent, but its distribution in the Arabian Gulf is not as well documented. It has been reported from the southern coasts of Saudia Arabia ,from the mouth of the Persian Gulf, and from the Red Sea, but Abbott questions the reliability of these reports and suggests that they may in fact be referring to juvenile specimens of *L. truncata sebae* (Abbott,1961:153). His suggestion is supported by the fact that Smythe doesn't mention this species in her book on shells from the Arabian Gulf, plus the fact that no specimens have been reported from the Makran coast or from Hawkes Bay near Karachi. There are only a few possible examples of this species reported from the sites in the Indus region, suggesting that, as is now the case, it was not common along the Makran and Sindh coasts during the 4th and 3rd millennium B.C.

SUPER FAMILY BUCCINACEA

FAMILY FASCIOLARIIDAE

Genus *Fasciolaria* Lamarck, 1799

Species *trapezium* Linnaeus, 1758

Accepted Nomenclature: *Fasciolaria trapezium* (Linnaeus, 1758)

Often referred to as the "sankh" shell in the early excavation reports from Mohenjo Daro and Harappa (Marshall, 1931 ; Mackay, 1938; Vats, 1936), this species was used almost exclusively for the manufacture of inlay pieces or beads during the later phase of the Indus Civilization.

Physical Characteristics

In terms of size and structure, this species is quite similar to the *Turbinella pyrum*, reaching about 180 mm in length and 110 mm in width. Unlike the *T. pyrum* however, it has a series of nodes or tubercles on the body whorl near the suture, spiraling from the apex to the outer lip. Being slightly elongated, fusiform in shape, it also has an elongated aperture. The columella is solid, spiraling and has two or three distinct columellar folds or ridges.(Fig.2-2) Although the columella is solid, it is not as massive or homogeneous as that of the *T. pyrum* and traces of the periostracum along with a yellowish brown discoloration are to be found spiraling up the center of the columella. The sutures are also poorly joined, making it impractical to produce circlets by cutting diagonally across the body whorl. A thin periostracum covers the exterior of

the shell, which is generally cream colored with traces of light brown around the sutures or along the growth lines.

Habitat

This species occurs in habitats similar to T. pyrum and often these two species can be found in the same beds (Hornell,1951:27), from the intertidal zone to about 20 meters. In some regions, such as the Gulf of Kutch, they occasionally occur in rocky areas or reefs, while in South India they are known to occur on muddier bottoms. This tolerance to environmental changes is probably the reason why they have such a widespread distribution.

Distribution

They are reported as being found throughout the Indo-Pacific Region from East Africa to the Philippines (Kaicher,1957). Along the coasts of the subcontinent, they are found in the Gulf of Kutch, as well as further south along the western and southern coasts (Melville and Abercrombie,1893:1-35). No examples have been reported from the Sindh and Makran coasts but Bosch has found numerous specimens along the rocky coasts of Muscat and Fahal Island in the Gulf of Oman (1982:107). It is interesting that Smythe does not mention the presence of this so-called common species from the interior regions of the Arabian Gulf. We know however, that large quantities of this species have been recovered from sites in Mesopotamia and in Egypt. Therefore, it is not unlikely that they did occur in

the Gulf during the protohistoric period, especially in view of its common distribution off the coasts of the Indian subcontinent, the Red Sea and East Africa.

FAMILY GALEODIDAE =MELONGENIDAE

Genus *Pugilina* Schumacker,1817

Species *bucephala* Lamarck,1799

Accepted Nomenclature: *Pugilina bucephala* (Lamarck,1799)

Synonymy: *Melongena bucephala* Lamarck,1799

Pugilina pugilina Born,1822

Although this species is not common at the major inland sites of the Indus Civilization, it was used on occasion at the smaller coastal sites for making bangles and possibly inlay.

Physical Characteristics

In both form and structure, this species is very similar to *Fasciolaria trapezium* but it is considerably smaller in size, reaching only 75 mm to 100 mm in length and 50 mm to 70 mm in width. Like the *F. trapezium*, it has a single series of nodes or tubercles on the shoulder of the whorls. In some of the larger specimens a second series of nodes can occur lower down on the body whorl, but this feature is not found on all specimens, and may be indicative of a specific ecotype. Many of the synonyms in nomenclature are due to these minor variations in shell morphology and only detailed studies in the future will be able to

determine which are ecotypes and which are isolated species. The shape is fusiform, but slightly shortened rather than elongated, and the aperture is ovoid. It has a solid, spiraling columella without any traces of columellar ridges. This feature is significant because it provides an easy clue to differentiate this species from either *F. trapezium* or *Turbinella pyrum* , when only a fragment of the columella is available. A thick periostracum covers the exterior of the shell, and it becomes imbeded in the sutures, weakening them so that circlets cut at a diagonal tend to break at the suture point.

Habitat

This species is found on rocky areas or reefs, from the inter-tidal zone to about 10 meters. Occasionally specimens can be found on the sandy areas between rocks , but they have probably been carried there by strong currents.

Distribution

Having a widespread distribution throughout the Indo-Pacific region , this species is found along the Makran and Sindh coasts, the Gulf of Kutch, and all along the coasts of the Indian subcontinent. Its occurance in the Persian Gulf is not confirmed, and Smythe has not reported them from this region.

CLASS: PELECYPODA or BIVALVIA

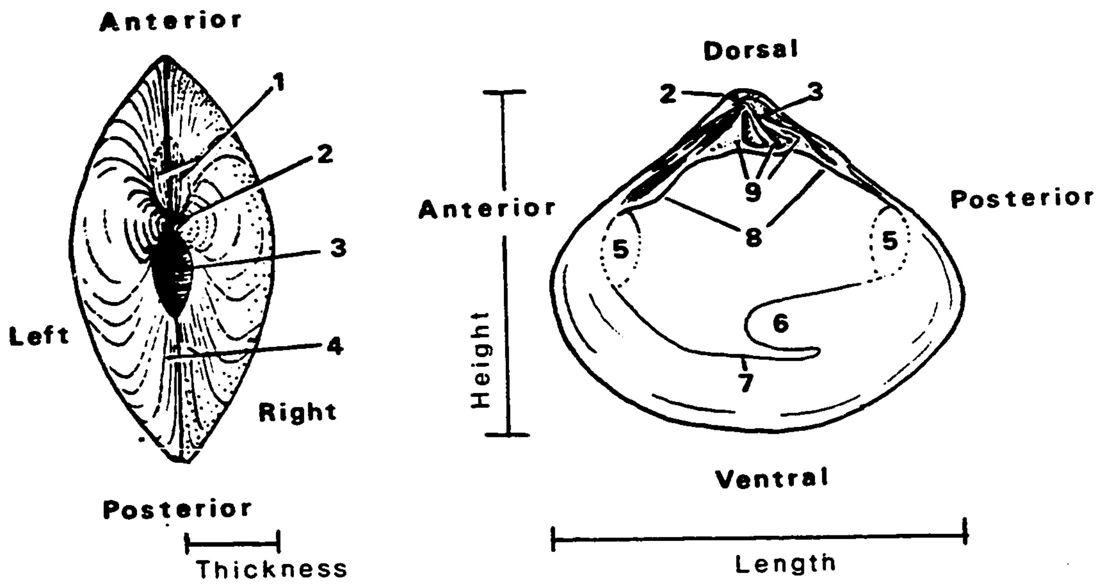
Although not quite as varied as the Gastropoda, there are over 15,000 living species of Bivalvia, 1200 of which live in fresh water habitats (Solem,1974:23). Two types of bivalve were exploited by the Indus peoples, one is grouped under epifauna: those moving freely on the sea bottom or attached permanently to objects, such as spondylus,oysters, mussels,etc. and the other is under infauna: those which bury themselves in sand or mud, such as clams, cockles, etc.(Solem,1974:78). The shape of the shell can often be used as an indicator of the different current conditions in their environment, particularly for the epifaunal varieties (Ibid.).

Before describing the particular species, it would be profitable to review the basic parts of a bivalve. (Fig.2-4) Each part of the valve has specific terms to differentiate important features used in the identification and comparison of various species. The dorsal edge or margin is where the two valves are joined together by a hinge-like structure. Holding both valves together and looking from the dorsal face, a depression called the lunule, points towards the anterior margin and the bonding ligament points to the posterior margin. Left and right hand valves are determined by orienting the anterior margin away from the viewer, or another easy rule is that the pallial sinus always points to the posterior margin, which

is to the right on the right valve and left on the left valve. On the interior of the right valve, the most prominent features are usually the hinge teeth. These fit into corresponding depressions in the left valve, and in many cases, it is the configuration of the hinge teeth that is used to determine the relationship between different species (Ibid:73).

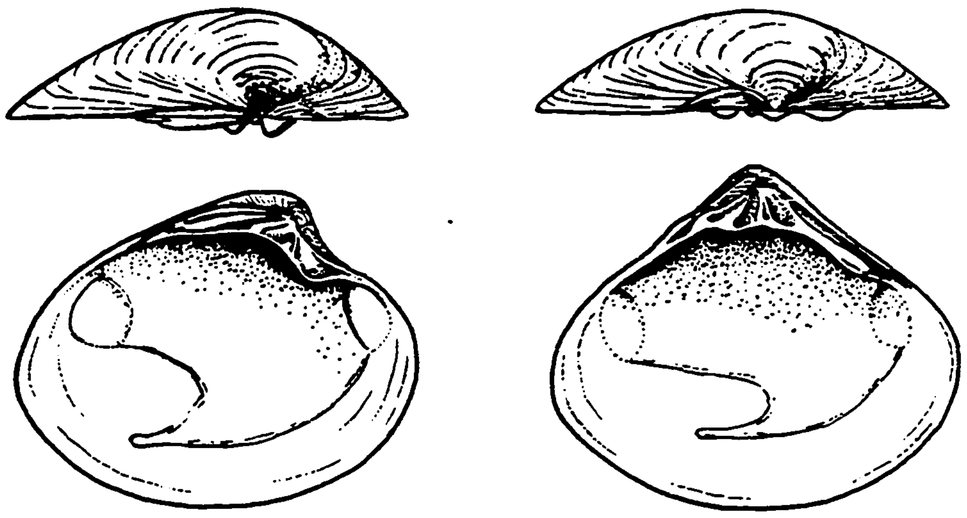
Due to the easily accessible habitats of most bivalves; in shallow bays, mud flats, estuaries, intertidal rocks and reefs, this Class has been much more exploited by man as a source of subsistence , than Gastropods. It is quite probable that species collected by the Indus peoples may originally have been collected for their food value and only later came to be used as a raw material for the manufacture of ornaments and utensils.

FIGURE 2-4. PARTS OF THE BIVALVE SHELL, Tivela damaoides.



1) Lunule, 2) Umbo, 3) Ligament, 4) Escutcheon, 5) Muscle scars, 6) Pallial sinus, 7) Pallial line, 8) lateral hinge teeth, 9) cardinal hinge teeth.

FIGURE 2-5. Callista impar (Lamarck) and Tivela damaoides (Gray).



CLASS	PELECYPODA
SUPER FAMILY	VENERACEA
FAMILY	VENERIDAE
Genus	*Tivela*
Sub-genus	*Cytherea* Lamarck,1799
Species	*damaoides* (Gray,1843)

Accepted Nomenclature: *Tivela damaoides* (Gray,1843)

Synonymy: *Tivela ponderosa* (Koch sic. Romer,1869)

There has been a certain amount of confusion regarding the identification of the archaeological specimens of this species. It was first noted at the Harappan site of Balakot in Southern Baluchistan, where it was used for making bangles (Dales and Kenoyer,1971). Specimens examined at the California Academy of Sciences were identified as *Meretrix casta* and "synonymously" by Silvio Durante in Rome, as *Callista casta* (Durante,1974) After considerable research and study it has now been determined that the most commonly used bivalve at Balakot was *Tivela damaoides*,Gray. It should be noted that the name *Meretrix casta* used by the author in the article, "Shell Working at Ancient Balakot,Pakistan",(Dales and Kenoyer,1977, *Expedition*), was in error, and should be corrected to *Tivela damaoides*, Gray. Furthermore, the Genus *Meretrix* cannot be considered synonymous with the Genus *Callista* as suggested by Durante, and must be considered improper nomenclature . Let it also be noted, however, that both *Meretrix* and *Callista* are

represented in the archaeological record at certain coastal sites, and will be discussed below.

Physical Characteristics

Tivela damaoides has a large massive shell comprised of two valves of equal size, generally as wide as long, with adult specimens reaching 90 mm by 90 mm.(Fig.2-4) It is markedly triangular in shape, and has a sub-convex dorsal profile , with a distinct lunule (Romer,1869:3). the cardinal teeth are quite large and well developed, radiating in straight lines from the umbo. The anterior lateral tooth on the left valve (Fig.2-5,b) is also quite large and has a low convex profile. A thin brownish periostracum covers the exterior of the shell, which is cream colored , with occasional streaks of light brown extending from the umbo towards the ventral margin. The pallial sinus is wide and deep, but generally does not extend more than half way across the shell.

Habitat

This species prefers to live in sandy areas with little mud, exposed to fresh salty water and strong tidal currents. This type of environment occurs on beaches open to the sea and are generally covered with water except during extremely low tides.

Distribution

Due to the numerous names given to similar species of bivalves and the variability of ecotypes, it has been

difficult to determine the world wide distribution of this particular species. I have personally examined specimens collected from the coasts west of Karachi as far as and including the Persian Gulf, as well as specimens from East Africa at the American Museum of Natural History, N.Y. and specimens from the Sindh and Makran coasts in the collections of the Department of Palaeobotony, U.C., Berkeley. This species is also reported from the Gulf of Oman (Durante:personal communication) and Zanzibar (Romer,1869:3). No record of its occurrence has been reported for the Gulf of Kutch or the remainder of the subcontinent.

Regarding their absence from the Gulf of Kutch and the remainder of the subcontinent, I rely on negative evidence in that no examples were found during my study of the collections from the Indian Museum, Calcutta , the Zoological Survey of India, Calcutta and also those at the Gujarat Marine Fisheries Research Institute at Okha. Furthermore, I have combed the beaches and shell markets in Bombay, Surat, Somnath, Dwarka, Okha, and Beyt without turning up any examples. In Karachi,however, both in the Zoological Museum, Karachi University and in the shell market on Clifton beach, numerous examples were available that had been collected along the coast west of Karachi.

Another species, Tivela polita, (Sowerby,1851) is also common in the Arabian Gulf and along the Makran coast. It

is often difficult to distinguish between *T. damaoides* and *T. polita* in juvenile specimens, but adult specimens tend to be " more elongate and not so equilateral in shape and the pallial sinus extends more than halfway across the shell and joins the pallial line towards the posterior edge" (Smythe, 1982:105). It is possible that this species was used along with *T. damaoides*, but the fragmentary nature of many of the arcnaeological specimens makes it difficult to differentiate between the two.

SUPER FAMILY VENERACEA

FAMILY VENERIDAE

GENUS *Meretrix* Lamarck,1799

Species *meretrix* Linnaeus,1758

Accepted Nomenclature: *Meretrix meretrix* (Linnaeus,1758)

In an extensive study of the different "species" of *Meretrix* found in Indian waters, Hornell (1917:153-173) found that there are three commercially important species that have a wide range of ecotypes: *Meretrix meretrix* L., *M. casta* (Chemnitz) and *M. ovum* Hanley. The only species that was used during the Indus period as a raw material for the manufacture of shell bangles is *Meretrix meretrix*. The other two species are considerably smaller and according to Hornell (*Ibid*.) have different geographical distributions, *M. casta* being found primarily on the east coast of the sub-continent and *M. ovum* on the west coast.

Meretrix meretrix : Physical Characteristics

The valves are trigono-sub-orbicular with smooth concentric growth lines and average adult specimens measure between 60 to 70 mm in length, 50 to 62.5 mm in height and 14 to 15.5 mm in thickness (of one valve) (Hornell,1918:20). Overall, the shell is cream colored but a dark, greyish-blue to bluish-brown extends along the postero-dorsal margin. This coloring varies greatly among the ecotypes and is not an important variable in identifying the species. The

periostracum is smooth, thin and a light brown color. The hinge is comprised of 3 prominent cardinal teeth, the anterior one on the left valve having a characteristic notch and a high convex anterior lateral tooth. The orientation of the cardinal teeth is slightly skewed, conforming to the general asymmetry of the valve itself. However, as with the coloring, the degree of skewing is quite variable from ecotype to ecotype.

Habitat

This species is generally found in sandy areas with little mud, and requires clean salty water to survive. Such habitats are found at the mouths of lagoons or estuaries where a strong tidal current flows (Hornell,1918:21). The spawning season appears to take place twice a year,in May and in September, and in South India these clams are collected throughout the year whenever the beaches are accessible.

Distribution

Although there are numerous ecotypes and hence much confusion over the identification of this species in different regions, it is reported from South India (Hornell,1918), Bombay (Melville and Abercrombie,1893:29) , the Gulf of Kutch (Kundu,1965), Karachi and the Makran coast (personal survey), and the Arabian Gulf (Smythe,1982).

Genus *Meretrix* Lamarck,1799

Species *ovum* Hanley,

Accepted Nomenclature: *Meretrix ovum* Hanley,

Physical Characteristics

In terms of basic morphological characteristics, this species is closely related to *M. meretrix*, and its shape varies from a swollen chordate form to an elongated, almost almond-shaped form (Hornell,1951: 67). It can be distinguished by a characteristic hinge structure of three cardinal teeth and a long anterior lateral tooth. In terms of coloring, there are two distinct brown rays radiating from the umbo to the ventral margin, while the rest of the shell has a greyish-cream tint. The average size is much smaller than that of the *Meretrix meretrix*, ranging from 35 to 40 mm in length and 25 to 28 mm in height. On the interior of the shell, the pallial sinus is also distinct in that it is hardly noticeable , except as a shallow concave dent in the pallial line.

Habitat

This species is hardier than *M. meretrix* and can tolerate muddy brackish water. Consequently its habitat extends further back in the estuaries and lagoons, making it more accessible to man. In south India, this species is more common in the markets than the *M. meretrix*, and is collected throughout most of the year.

Distribution

As was mentioned above, this species is found primarily on the west coast of the Indian sub-continent, the Gulf of Kutch and the Makran and Sindh coasts west of Karachi. Its presence in the Persian Gulf is not confirmed.

Genus Callista,

Species impar Lamarck,1799

Accepted Nomenclature: Callista impar (Lamarck,1799)

Physical Characteristics

In size and shape this species is very similar to M. meretrix but they can be easily distinguished on the basis of their hinge teeth structure and the location of the pallial sinus (Fig.2-5a). Callista impar has two equal valves, slightly skewed towards the anterior margin. The hinge is comprised of three cardinal teeth and a high convex anterior lateral tooth. A smooth thin periostracum covers the shell, which is cream colored except for a light purple tinge on the posterior margin. This purple coloring penetrates into the interior of the shell. The average size range is from 60 to 70 mm in length, 45 to 50 mm in height and 12 to 17 mm in thickness (of one valve).

Habitat

Like Meretrix ovum, this species is found in muddy sand banks inside lagoons and estuaries. It requires salty to brackish water throughout the year.

Distribution

This species is often confused with *Meretrix meretrix* because it is found in the same geographical regions. Specimens examined by the author come from the Makran and Sindh coasts west of Karachi, as far as Gwadar. It is reported as having a general Indo-Pacific distribution (Romer,1869:57).

FRESH WATER AND TERRESTRIAL MOLLUSCA

Many species of fresh water and terrestrial mollusca are found in the archaeological record at sites of the Indus civilization, but very few show evidence of having been used as tools or ornaments. The only commonly used species are the fresh water bivalves of the Genus *Lamellidens*, Simpson. This genus has numerous species that are not well defined in South Asia, and many have overlapping geographical distributions. The most common species, *Lamellidens marginalis* has a widespread distribution throughout the subcontinent and it is unlikely that it was ever traded from one region to another. Many of the other species found in the archaeological sediments appear to be incidental and were not brought there intentionally for any specific purpose by the Indus people. Compared to marine gastropods, these species are relatively unimportant for purposes of understanding trade networks or stylistic variations in shell objects, therefore, it is not necessary to go into detail describing the numerous ecotypes or variants. It should be noted, however, that these fresh water species are extremely valuable in terms of understanding palaeoenvironments. both on a world wide and a local level, as well as for dating major geological deposits (Sparks,1970). Listed below, are the major genera and species that are commonly found at most Indus sites.

CLASS GASTROPODA

ORDER MESOGASTROPODA

FAMILY VIVIPARIDAE

Genus *Viviparus* de Montfort,1810

Species *bengalensis* Lamarck,1799

Accepted Nomenclature: *Viviparus bengalensis* (Lamarck,1799)

Although occasional examples of this species are found with crude perforations, there is no evidence to suggest that they were regularly used as ornaments during the Indus Period. They may have been collected casually for food or as curiosities, but due to the fact that no large quantities of their shells have been recovered from any site, their occurrence can be seen as coincidental.

Physical Characteristics

The general form of the shell is conoidal and spiraling, with an obtuse apex and convex whorls. The shell is very thin and fragile, and when alive it is greenish colored with narrow dark green bands (Preston, 1915:83). In the archaeological context the shells are bleached white and generally fragmentary. Numerous ecotypes occur in different, but overlapping geographical regions, and they range in size from 30 to 40 mm in length and 20 to 30 mm in diameter.

Habitat: In perennial moist areas.

Distribution: General South Asian Subcontinent and adjacent

regions.

ORDER PULMONATA

FAMILY ACHATINIDAE

Genus *Zootecus* Westerlund,1887

Species *insularis* Ehrenberg,1848

Accepted Nomenclature: *Zootecus insularis* (Ehrenberg,1848)

Sub Species *Zootecus insularis chion* (Pfeiffer)

(Identified by A. Solem from Allahadino, Turnbull,1982)

This species does not appear to have been intentionally utilized by the Indus peoples although it does occasionally occurs as an inclusion in pottery or mud bricks.

Physical Characteristics

The shell has a compact pupiform shape with a conical apex and 7 to 10 convex whorls. A multitude of local variants occur , but they generally range in size from 10 to 15 mm in length and 3 to 5 mm in diameter (Gude,1914:367).

Habitat: In perennial moist areas, chiefly in arid or barren regions.

Distribution: Sahara to Arabia, general South Asian Subcontinent and adjacent regions.

ORDER PULMONATA

FAMILY PLANORBIDAE

Genus *Indoplanorbis* Annadale and Prashad,1920

Species *exustus* Deshayes,1834

Accepted Nomenclature: *Indoplanorbis exustus* (Deshayes,1834)

Synonymy: *Planorbis exustus* Deshayes,1834

Physical Characteristics

The shell is made up of 3 major whorls, the last being the largest, and the spire is depressed. Various forms occur, but in most, the aperture is angularly raised, then depressed, sloped and expanded below (Preston,1915:116). As with the other genera, there are numerous ecotypes, but the general size ranges from 8 to 10 mm in length and 15 to 20 mm in diameter.

Habitat: In perennial moist areas.

Distribution: World-wide, General South Asian Subcontinent.

ORDER MESOGASTROPODA

FAMILY THAIRIDAE

Genus *Melanoides* Olivier,1804

Species *tuberculata* Müller,1774

Accepted Nomenclature: *Melanoides tuberculata* (Müller,1774)

ORDER PULMONATA

FAMILY ELLOBIIDAE

Genus *Cassidula* Ferussac,1821

Species *aurifelis* Bruguiere,1789

Accepted Nomenclature: *Cassidula* (*Cassidula*) *aurifelis* (Bruguiere,1789)

Other species: *Ellobium* *aurisjudae*, (Linnaeus)
(Identified by A. Solem at Allahadino)

CLASS BIVALVIA

FAMILY UNIONIDAE

SUB-FAMILY HYRINAE

Genus *Parreyssia* Conrad,1853

Species *favidens* Benson,1900

Accepted Nomenclature: *Parreyssia* *favidens* (Benson,1900)

This species is quite common at Indus sites, but I have not found any examples that show definite evidence for use as tools, ornaments or utensils. Due to the fragility of the shell, most examples are broken, and though the interior is nacreous, it is unlikely that they were used to make any of the "mother-of-pearl" ornaments that have been found in the excavations.

Physical Characteristics

The shell is comprised of two equal valves, oval to sub-rhomboid, with full high radially sculptured umbo. The cardinal teeth are strong, jagged and not lamellar. A thick greenish-brown periostracum covers the exterior of the shell, while the interior is nacreous (Preston,1915:159). Some of the ecotypes are larger than others, but usually the

shell ranges from 30 to 40 mm in length, 25 to 35 mm in height and 10 to 15 mm in thickness (of one valve).

Habitat: Riverine or lacustrine, buried in silty, muddy banks or bottoms.

Distribution: General South Asian Subcontinent.

Genus Lamellidens Simpson,1900

Species marginalis Lamarck,1799

Accepted Nomenclature: Lamellidens marginalis (Lamarck,1799)

Synonymy: Unio marginalis Lamarck,1799

Lamellidens testudinarius (Spengler,1890)

This species is found at most Indus period sites and generally occurs with a crude perforation just above the umbo. Many of these perforated shells have wear on the ventral edge indicating their use as scrapers, but others may have been simply used as crude pendants .

Physical Characteristics

The shell is comprised ot two equal valves, elongate, pointed behind with a slight post-dorsal wing. The umbo has curved radiating ridges, that occasionally begin flaking off in older specimens. A smooth brownish periostracum covers the exterior and the interior is nacreous (Preston,1915:174 . Many different ecotypes occur, but the general size ranges from 75 to 100 mm in length, 30 to 60 mm in height and 12 to 20 mm in thickness (of one valve).

Habitat: Riverine or lacustrine, in silty/muddy banks or bottoms.

Distribution: General South Asian Subcontinent.

FOOTNOTES

1. Smythe states that her book does not include all known species from the Persian Gulf, in fact, some of her specimens have yet to be identified. On the other hand, it includes the most common and easily accessible species. Her identifications are based on a detailed critical study of the major collections from this region and their identifications. One of the major collections that she draws on is that made by Captain Townsend between 1890 and 1914, covering the deeper coastal waters from Karachi to Muscat in the Gulf of Oman, and all through the Arabian Gulf as far as Fao, at the head of the Gulf (Smythe,1982:22). Most of Townsend's collections were identified by early scholars,such as G.B. Sowerby, J.C. Melvill, R. Standen and others. Currently, various Arabian, Iranian and Pakistani Universities are carrying out research along the Makran coast and the Arabian/Persian Gulf region in an attempt to further clarify the distribution and identification of each species and their numerous ecotypes.

2. According to OPINION 489 of the International Commission on Zoological Nomenclature (1957-58,Vol.17:157-58), the Generic name Turbinella, Lamarck,1799 was chosen over Xancus,(Röding,1798), and the specific name pyrum ,Linnaeus,1767 was retained.

Furthermore, the Family name TURBINELLIDAE Swainson,1840 was chosen over the name XANCIDAE Woodring, 1928. The accepted nomenclature would then be: Family: TURBINELLIDAE Swainson,1840; Genus: *Turbinella* Lamarck,1799 ; Species: *pyrum* Linnaeus,1767.

3. Mahadevan and Nagappannayar,1974:118-11 "From the studies of the nature of bottom in the regions investigated so far it is evident that the sandy sea bottom in which chanks are found can be divided into the five following categories:

a) Coarse sand region with plenty of worn out,drifted, brown coloured, broken shell of the species of *Arca*,*Anomia*,*Cardium*,*Crucibulum*,*Bulla*, *Meretrix*,*Nassa* and *Dentalium* along with small molluscs, echinoid spines, quartz grains and a few foraminifera shells. This area extends from 8 metres up to 13 metres limit.

b) A region with sand grains of brownish colour in between coarse and fine grade, inhabited by *Clypeaster humilis*, *Salmacis bicolor*, *Holothuria atra* and *Murex tribulus*. The percentage of broken shells was less while that of foraminifera shells was higher than in the previous region. The area extends from 13 to 17 metres.

c) A region of fine sand of silky texture, superficially muddy coloured with loosely lying small corals, dense growth of *Solenocaulon* sp., *Pteroides* sp.,*Virgularia*

sp., tests of Echinolampas sp., Clypeaster humilis, occasional Astropecten sp.,Rhabdocynthia sp. and sea anemones like Stoichactis giganteum. Broken shells were rare while foraminifera shells were fairly common. The area extends between 18 and 23 metres. The sandy bottom appeared furrowed.

d) A region of very fine loose sand in furrowed formation with Rhabdocynthia sp., alcyonarians, pennatulids, a few Holothuria atra, filamentous green algae, etc. This region extends from 23 to 27 metres. The floral population here consisted of Avrainvillea sp., Halophila ovalis and Cymodocea sp.

e) A region of sand, spread along the periphery of the rocky areas. This showed a mixture of all conditions seen in b),c) and d). Here the sand was spread 10 to 25 cm over the hard bottom. Porolithon sp., dead coral pieces, scattered calcareous sea-weed Halimeda sp., algae belonging mostly to Rhodophyceae group grew here and there and dead shells were seen in addition."

CHAPTER III. SHELL INDUSTRIES OF THE SINDHU/NARA PLAIN.

Introduction

In this chapter we will be examining the development and character of shell working industries in the Sindhu/Nara plain, focusing on the Mature Indus period. But, first it is necessary to understand the background from which this tradition emerged. Our earliest evidence for the use of shell comes from the Aceramic Neolithic period (c. 6th millennium B.C.) at the site of Mehrgarh, Pakistan (Jarrige,1977). It is fortunate that the sample of shell artifacts from Mehrgarh is relatively large, because very few Neolithic sites have been excavated in Baluchistan or the Indus region and little or no shell has been reported from this period. Because of this lack of comparative data, the significance of the Mehrgarh sample must be kept in perspective, especially since the site is located in a transitional zone at the edge of the Sindhu/Nara plain and the highlands of Baluchistan. For the Early Chalcolithic period there is also very little evidence, but again , Mehrgarh provides one important sample. Later, during the Early Indus (Harappan) period we have several widely scattered sites with relatively small samples of shell. Some of these artifacts, particularly from the site of Amri, show important technological and stylistic developments

during this formative period, when the industry was becoming more specialized.

With this background in the early developments, we can look more critically at the wide range of variation and specialization that is seen during the Mature Indus Period. Almost all sites of this urban period produce some evidence for the use or manufacture of shell artifacts, and it has been necessary to limit the discussion here, to those sites having the most informative samples, in terms of both quantitaive and qualitative data. Each major region of the Indus Civilization is represented by important stylistic and technological variations, which are partly related to the availability and access to the raw shell. These variations provide important cultural indicators for inter-site comparisons and for understanding the complex trade/exchange connections between the coastal resource areas and inland sites.

In order to allow for an uninterrupted presentation, I have chosen to discuss the evidence for use and manufacture of shell during the Neolithic and Early Chalcolithic Periods together, followed by the Early Indus , and the Mature Indus. Each major site will be discussed separately, with a brief summary of chronology and the relevant features of material culture. A detailed discussion of the shell industry will then be presented, along with appropriate tables, maps and artifact drawings. Primarily we will be looking at those aspects of artifact morphology and specific

measurements that pertain to the discussion of technological and stylistic variation. Each site contains numerous unique shell artifacts that need not be discussed here, but they will be published separately or included with the excavation reports of the original excavators. A summary of the recording and classification system developed in the course of my field work is presented in Appendix II, and tabulations, comparative charts, etc. will be presented for each specific site in Appendix III.

Neolithic and Early Chalcolithic Period

Mehrgarh

The most important evidence for early human settlements in the Sindhu/ Nara plain comes from the site of Mehrgarh, Pakistan. Here, the French Archaeological Mission has uncovered a sequence of habitation levels extending over 5000 years, from the 7th millennium B.C. to the 3rd millennium B.C. At this site, we also find the earliest evidence for the use and manufacture of shell ornaments in this region, therefore it is necessary to provide a more detailed summary of the cultural aspects and affinities of each major period than will be done for other pre-Indus period sites. Before beginning any discussion, it must be pointed out that this site is still being excavated, and the shell artifacts in this sample represent only those examples that had been discovered up until January,1983. Another factor that must be considered, is the fact that some areas have been more fully exposed than others and that artifact rich deposits such as burials, can radically change artifact percentages. Therefore, it is unwise to use the percentages of shell artifacts from each period as a primary indicator, i.e. of coastal contacts or trade, until the total exposed areas and types of deposits from each period can be taken into account.

Situated on the alluvial plain of the Bolan River, just at the base of the Baluchistan Hills, this site formed a

link in the major land route connecting the plains with the highlands. Proceeding up the Bolan River, this route crosses the Bolan Pass and reaches the highland valley of Quetta and the lower valleys of Kandahar and Seistan. The earliest levels at Mehrgarh, Period I (Aceramic Neolithic) are dated by relative chronology and C14 dates to the 7th or 6th millennium B.C. (Jarrige and Meadow,1980:122 ; Jarrige,1981). Over 10 meters of Neolithic deposits have been exposed through recent erosion by the Bolan River, and these provide evidence for a series of permanent farming settlements where the inhabitants lived in multiroom structures made of crude mudbricks. Quite a large number of human burials have been discovered in the open spaces between these structures, and it is from these burials that most of the shell artifacts have been recovered. Other artifacts include; grinding stones, geometric blade tools with "sickle-sheen", bitumen covered baskets, unfired clay figurines of humans and animals, polished stone axes, bone tools, beads made from locally available raw materials and also foreign materials such as lapis lazuli, turquoise and marine shells. These foreign raw materials indicate the early development of long distance trade/exchange contacts with the mountain regions to the west and the coastal regions to the south. No pottery has been found in the lowest levels of the site, and even though a copper bead has been recovered from a child burial, this period is referred to as the Aceramic Neolithic (Jarrige and Meadow,1980:128).

In the succeeding Period II (Ceramic Neolithic), the settlement shifted to the south and there were new additions to the material culture that is a limited amount of chaff tempered, handformed pottery that can be compared with pottery from Kile Gul Muhammad II (Jarrige,1979:533). Later in Period IIB there are larger quantities of this ware and new varieties of a finer, handformed painted pottery. Some of these vessels appear to have been manufactured using a tournette and have parallels at the sites of KGM III and Mundigak I,1-3 (Ibid.). On the basis of C14 dates and other comparisons with dated sites to the west, Jarrige dates this period to the late 6th and early 5th millennium B.C.(Jarrige, 1981:14). Besides these developments in ceramic technology, several other types of craft specilization begin to appear; bead manufacture, ivory working, bone working and shell working. In terms of subsistence, there is a marked change from the exploitation of wild animals to the herding of domestic cattle, sheep and goat (Meadow, 1981:143-180). Only a few small copper artifacts have been recovered, but as in Period I, turquoise and lapis lazuli beads are found in some of the burials. The occurrence of these exotic items indicats the continued trade/exchange contacts with northern and western Afghanistan, as well as eastern Iran and Central Asia. One major source of lapis lazuli occurs in Badakshan, Northern Afghanistan, but a second closer source has now been located in the Chagai Hills region of Baluchistan/Afghanistan

(Jarrige, pers.communication).

At the beginning of Period III, the settlement shifts further to the south at around 4000 B.C. This period shows definite evidence for the processing of copper ore and the early development of copper technology, placing it firmly in the Chalcolithic category. The pottery shows some continuity with the finer wares of the previous period II, but a new range of wheelmade types appear, with distinctive painted motifs of goats and birds (Jarrige and Meadow,1980:130). Besides this early evidence for the use of the fast wheel, specialized drill bits of green jasper (pthanite) and partly drilled chalcedony beads proved the earliest evidence for the use of a bow drill in this region (Ibid.). Furthermore, a few sawn shell fragments have also been found indicating the earliest evidence for the inland manufacture of shell bangles (see below). These developments in craft specialization and technology are paralleled by advances in agricultural techniques, such as mixed cereal farming, and the continued emphasis on livestock herding (Ibid.). A few burials have been found from this period, and though they do not have many grave goods, one grave is reported as having a dentalium necklace (Samzun,A. in Jarrige,1981:19).

The subsequent period IV is dated by C14 to around 3500 B.C. (4190+/-140, MASCA correction c. 3110 B.C.,Jarrige ,1978:18), and once again the settlement shifts to the south. During this period there is evidence for the mass

production of plain pottery and also a change to geometric polychrome painted motifs on the decorated wares. Jarrige interprets these developments as a response to a more diversified market demand, probably in the western mountain regions (Jarrige and Meadow,1980:130). It is interesting that very little shell has been recovered from this period, and most examples come from disturbed surface contexts. This same situation occurs in the last three major periods, V,VI,and VII. From Period V, dated to around 3200 B.C. to the end of Period VII, around 2600 B.C., we see the full development of a proto-urban agricultural community. Stone tools still play an important role in their use in sickles, and although pottery manufacture has now reached a semi-industrial level, the firing techniques have remained unchanged from those used in period II. The final phase of Period VII is probably contemporaneous with the Early Indus Period on the basis of Kot Dijian and Amri IIB types of pottery (Sable, F. in Jarrige,1981:27).

Mehrgarh Shell Industries

The shell artifacts from Period I (Aceramic Neolithic) are comprised primarily of ornaments that can be grouped on the basis of morphological features and their relative positions in burials, into three major classes; Beads, Pendants and Bangles. Almost all of these ornaments have been manufactured from marine shell species whose nearest source is the Arabian Sea, some 500 km to the south. As was mentioned above, most of the shell artifacts from this

period come from burials, and although some of these ornamanets are fragmentary, all are finished and show evidence of having been worn for a considerable time before being interred. A few artifacts made of locally available fresh water mollusca occur and some of these have been perforated. Other than these few examples, there is no evidence for the manufacture or processing of shell materials at the site during Period I.

TABLE 3-1. MEHRGARH: MARINE SHELL ARTIFACTS, PERIOD I AND II

ARTIFACT TYPE	SPECIES	I	II
BEADS: Cylinder Disc	Spondylus exilis	998+	0
	Cardium/Arca sp?	5	0
Cylinder (Short and Long)	Dentalium, sp.	120+	17
	Cardium/Arca, sp?	22	4
	gastropod, species ?	1	0
Tabular	Cardium/Arca, sp?	114+	1
	Turbinella pyrum	1	0
Irregular	Conus, sp.	1	0
	Pinctada, sp.	4	0
	Cardium/Arca, sp?	1	0
PENDANTS: Shaped	Conus, sp.	5	0
	Pinctada, sp.	5	1
	Spondylus exilis	1	0
	bivalve, species?	1	0
Natural Shell	Nerita, sp.	1	0
	Littorina coccinea	3	0
	Terebellum terebellum	2	0
	Erosaria ocellata	0	1
	Polinices tumidus	0	2
	Engina mendicaria	14	0
	Spondylus exilis	1	0
	Cardium assimile	7	0
	Callista impar	2	0
	Donax, sp.	1	0
INLAY ?	bivalve, species?	0	1
BANGLE: Plain	Turbinella pyrum	2+	2
OTHER: Fragments	Cardium, sp.	3	0
	Pinctada, sp.	0	1
	Anadara= Arca, sp.	0	1
	Donax, sp.	7	0
	gastropod, species ?	0	1
Chipped columella	Strombus, sp.	0	1
Perforated "	Strombus, sp.	0	9
	Total	(1322)	(42)

In general, the marine species represented in Period I are found along the Western Coast, but a more detailed examination of specific habitats reveals some interesting

patterns. In terms of collection, the range of species shows evidence for the exploitation of several different coastal resource areas. The *Spondylus* sp. comes from rocky shores, *Pinctada* sp. from shallow sandy areas or reefs, *Callista* sp. from sandy beaches, lagoons and estuaries, *Turbinella pyrum* from shallow bays, and the rest from mixed rocky/sandy intertidal and littoral zones. In terms of specific distributions, the *T. pyrum* is found primarily in the east along the Karachi coast and only as far west as Pasni, while *Pinctada* sp. is more common to the west near Qwadar and Ras Jiwani. Another common species, *Engina mendicaria*, found at many sites in West Asia (Shahr-i-Sokta, Tepe Yahya sic. Durante,1977; Tosi et al. 1982), is less common along the Karachi coast than on the Makran coast (Durante,1975:28). Before discussing the implications of these distribution patterns in relation to coastal access and trade/exchange, let us first look at the important stylistic and technological aspects of the Neolithic shell industry.

The absence of manufacturing waste during the Aceramic Neolithic, Period I, suggests that these ornaments were being manufactured in regions nearer the coast. As of yet, no contemporaneous shell working sites have been discovered either in western mountain regions or along the Makran or Sindh coasts. Nonetheless, certain technological aspects of the manufacturing technology can be reconstructed though a detailed examination of the finished artifacts themselves.

The most numerous type of bead is the cylinder disc bead, made from Spondulus exilis (Fig.3-1;3,5,7). The diameter of these tiny beads vary from one portion of a neclace to another, but specific groups of beads all tend to have the same diameter; grading from 3.8 to 4.2 mm, 4.7 to 5 mm, 6.8 to 7.4 mm etc. In terms of thickness however, there is a wide range, from .7 to 1.8 mm and even on a single bead, the thickness will vary from one edge to the other.

These beads appear to have been produced using a well documented process recorded from archaeological and ethnographic contexts throughout the world (Foreman,1978; Safer and Gill,1982). Basically the top valve of the Spondylus was broken into small fragments by smashing or snapping them between grooves in rocks (Foreman,1978:18). These tiny fragments were then drilled using a perçoir, a stone tipped drill or some other hard material with an abrasive. After perforating a substantial number of small chips, they were strung on a fibre cord or sinew. This long string of rough beads was then rubbed against a flat stone using sand and water as abrasive and lubricant. By this gradual process of abrasion and rotation, the beads attain a uniform diameter, but their thickness varies according to the part of the shell from which the chip was broken. During the grinding process, these irregular faces are smoothed by rubbing against each other, resulting in closely fitted beads. Foreman's replicative experiments have demonstrated that it takes from 2 to 4 months to produce a

single strand of disc beads; from the collection of the raw materials to the final polishing (1978:22). In some cultures, such as among the Pomo tribes along the central California coast, similar disc bead necklaces had special economic values relating to the diameter of the beads and the length of the necklaces, and they also had specific ritual significance. Because of the cultural values attached to these beads, the drilling and polishing was relegated to specialists who had learned the craft through long apprenticeship (Safer and Gill,1982:56). It is unlikely that we will ever be able to understand the socio-economic processes by which the disc bead necklaces were produced in Baluchistan during the Neolithic period, but we can be certain that the long strings of disc beads found in the burials at Mehrgarh represent considerable socio-economic and possibly even ritual value.

The other types of beads and pendants were all made individually, using various processes of chipping, drilling, grinding and polishing. The biconical section of the drill holes in the larger beads, indicates that they were drilled from both sides, and that the drill was probably made of chert or some other hard stone. The exterior diameter of the perforations are generally quite large, up to 5 mm while the interior hole often is less than 2 mm in diameter, indicating the use of a fairly unsophisticated pump drill or bow drill. Natural shells (see Table 3-1) were perforated by grinding or chipping with a hard pointed tool. Recent

studies of shell perforating techniques at the site of Ras Al Hamra, Oman indicate that even shell points were used to make some perforations (H.G.Gelb, pers.comm.) Most of the shell pendants at Mehrgarh were either smoothed or left with the natural shell surface, but there are a few examples where simple designs have been incised. One of the Pinctada pendants is eliptical in shape and incised with shallow radiating lines all around the outer edge, while on both of the Terebellum pendants, there are irregular lines incised on the sides. These simple designs were probably made with hard chert blades, which can very quickly cut the relatively softer shell.

The only other major manufacturing process is seen from the few examples of shell bangles. These were made from the large gastropod, Turbinella pyrum and only one wide bangle was made from each shell. It is difficult to reconstruct the full manufacturing process during this period because we only have a few finished and heavily worn examples, but the most logical method would have required a considerable amount of hammering and chipping to remove the thick hard columella. The anterior portion of the the shell might have been sawn off with a chert blade, or just as easily chipped and then ground smooth. Finally, the rough interior portion was probably ground and smoothed using a cylindrical piece of sandstone and the exterior was ground on a flat piece of sandstone (Dales and Kenoyer,1977:15).

Only two bangles have been recovered so far from Period

I; one is complete,(Fig.3-1;1) and comes from the burial of a small child, where it was placed over the pelvis, and the other is just a fragment. The width of the complete bangle ranges from 29 to 45 mm and the interior diameter is irregular, from 55 to 63 mm. On the outer edge of the bangle, there is a partly drilled hole , but otherwise there is no exterior decoration. The other bangle fragment is also plain, and is 33 mm wide.

As we can see from this brief discussion, all the different processes used to manufacture shell artifacts during the Aceramic Neolithic, employ the same basic tools used for various other modes of production or food processing;i.e. hammerstones, grinding stones, chert blades, percoirs and drills. At the present, there is no evidence to suggest the development of any specialized tool type for the manufacture of shell objects during this period.

In Period II, the total number of shell artifacts drops considerably, but this is most probably due to the fewer number of burials that have been excavated and the absence of Spondylus disc bead necklaces from these burials. So far most burials from Period II have had very few grave goods, and no examples of disc bead necklaces. This may represent a significant change in socio-ritual traditions, but the discovery of one burial with a Dentalium bead neclace indicates that some tradition of including shell ornaments still persisted. Until more burials have been discovered

from Period II it is difficult to come to any conclusions. Other types of ornaments still occur, cylinder and tabular beads (Fig.3-1;19), a Pinctada pendant, and perforated examples of Polinices tumidus and Erosaria ocellata. The similarity in styles, of tabular beads could indicate the continued contact with the trade/exchange network of Period I, or the reuse of older beads. One note of caution is necessary regarding the presence of Polinices tumidus and Erosaria ocellata pendants during this period. These artifacts are all from disturbed suface contexts, and since these ornaments are commonly used by the local inhabitants of this region today, it is quite probable that some of them are modern and not from the 5th millennium B.C. The Polinices pendants from periods III to VI are also all from similar surface contexts, and to my knowledge, no examples have been discovered yet in good stratigraphic contexts.

A few examples of wide Turbinella pyrum bangles have been recovered (24 to 27 mm in width), indicating their continued use, but there is still no manufacturing waste that would indicate their manufacture at the site itself. On the other hand we do have evidence for the manufacture of a new and intriguing artifact made from the columella of a small Strombus shell (species not determinable). (Fig.3-1;15,16,17). Some of the columella are only partly chipped, providing the first concrete evidence for the manufacture of marine shell artifacts at the site itself. Basically, the body whorl and septa were chipped away,

leaving the thick anterior portion of the solid columella. Then, the columella was perforated through the long axis by drilling from both ends. The odd part about these objects is that the rough edges of the spiraling septa were not ground down as would be expected it it were to be used as an ornament. And yet, the exterior surfaces and the interior of the perforation are heavily worn from long use. Perhaps these objects had some specific utilitarian function ? (Fig.3-1;17) One other interesting artifact is a flat, almond-shaped piece of shell that is similar to the "inlay" manufactured during the Mature Indus Period (Fig.3-1;18). Regardless of whether this piece was actually used as inlay or not, it does indicate a use of shell that was probably unrelated to personal adornment.

Looking now at Period III, the Early Chalcolithic, we see a marked change in the type of shell artifacts being used and the dominance of one species, Turbinella pyrum as primary raw material. The most common shell artifacts are bangles, either plain or grooved and for the first time in the history of the Sindhu/Nara region, we have evidence for their manufacture (Fig.3-1; 20,21). These manufacturing wasters indicate that the anterior portion of the T. pyrum was being chipped and then sawn to obtain a wide circlet for making into a bangle. The interior portions of these waste pieces have been ground smooth for some other secondary use, so it is not possible to determine how the internal septa were broken. Further excavations will hopefully turn up

other waste fragments to help us more fully reconstruct this phase of manufacture. The saw cuts on the three waste pieces, are wide and shallow (>2mm), indicating the use of a fairly crude sawing tool, most probably a chert blade. No copper saws have been found yet, but if a copper saw had been used, it would have been possible to cut through the entire thickness of the shell from the exterior. On two of the examples however, the shell has been partially sawn on the interior as well as the exterior and then snapped. The irregularly aligned striae left by the cutting tool also suggest the use of a chert blade rather than a copper/bronze saw.

After having removed the apex and anterior portions, a wide circular band, perpendicular to the central axis was produced. This wide band was then smoothed on the inside and outside, resulting in a heavy, wide bangle. However, we see that in Period III, not all the bangles from are wide, in fact they range from 33 mm to as thin as 4 mm. The wider ones, 20 to 33 mm, each represent a single T. pyrum shell, but the thinner examples indicate that in some cases, more than one bangle was being made from each shell. This could have been done by tediously sectioning the larger wide bangle with chert blades and then snapping them apart, or by a different manufacturing process using a copper/bronze saw. Since we have no evidence for sectioning the wide bangles, and we have no examples of copper/bronze saws, it is possible that these bangles were not made at the site or are

out of context. Most of the thinner bangles have been recovered from disturbed surface contexts, and along with them, we see the occurrence of numerous fragments of grooved bangles. These grooved bangles are generally quite fragmentary, but three examples have their original width preserved (Table 3-3). Various types of grooved designs are represented; a single deep groove, producing a double ridge (Fig.3-1:23); several deep grooves, producing 4 or 5 ridges (Fig.3-1,22); and 2 or 3 wide shallow grooves (not illustrated). The presence of grooved bangles at this early period is somewhat unusual, because this type of decoration has been recorded only at one site during the Early Indus Period (Gumla III) and then later at the mature Indus sites in Kutch and Kathiawar. During the Early Historic and Medieval periods, however, this type of design becomes quite common, and is still to be found on ivory and shell bangles throughout the subcontinent. With these factors in mind, the occurrence of very thin bangles and wide grooved bangles at 4000 B.C. must be treated with some reserve until more excavations provide reliable stratigraphic evidence for dating them to this early period.

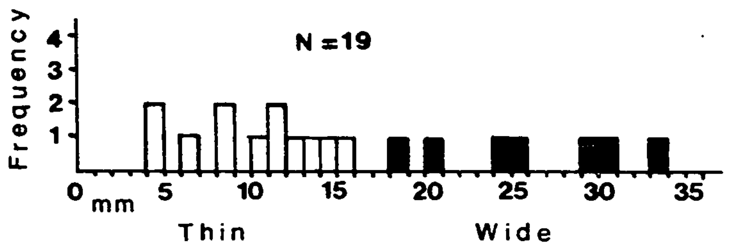
TABLE 3-2. MEHRGARH: MARINE SHELL ARTIFACTS, PERIOD III

ARTIFACT TYPE	SPECIES	EXCAVATED	SURFACE	TOTAL
BEAD? Cylinder	*Dentalium*, sp.	C	6	6
	gastropod, species?	1	0	1
PENDANT, Natural Shell	*Polinices tumidus*	0	3	3
BANGLE, plain	*Turbinella pyrum*	7	29	36
grooved	*Turbinella pyrum*	1	15	16
MANUFACTURING WASTE, Sawn	*Turbinella pyrum*	2	1	3
,Chipped	*Turbinella pyrum*	0	2	2
OTHER FRAGMENTS	species?	0	1	1
	Nerita, sp.	0	1	1
	Telescopium telescopium	0	1	1
	Total	11	59	70

TABLE 3-3. MEHRGARH: SHELL BANGLE WIDTHS, PERIOD III

		Mean Width	Standard Deviation	Minimum	Maximum
PLAIN	n= 19	15.8 mm	.90	4 mm	33 mm
GROOVED	n= 3	18	.72	10	22

TABLE 3-4. MEHRGARH: PLAIN BANGLE WIDTHS, PERIOD III



As was mentioned above, very little marine shell has been recovered from the later periods at Mehrgarh, and it is still too early to discuss the developments or character of the industry during periods V to VIII (APPENDIX III;1,III:2). In Period V there is evidence for the use of Dentalium beads, and one example each of a Turbinella pyrum bangle and the perforated columella of Strombus sp., like those found in Period II. From Periods VI to VII, two perforated natural shells have been found; one of Oliva bulbosa and the other of Natica lineata. So far, no shell has been reported from the cemetery of Period VIII.

Other Neolithic and Early Chalcolithic Sites

Although we have considerable evidence for the use of shell at the site of Mehrgarh, there is little comparative data from stratified contexts, either in the Sindhu/Nara plains region or the mountainous regions to the west. This lack of data is undoubtedly a result of scanty research in the western and coastal regions, and the inaccessibility of early sites in the alluvial plains region.

The most extensive surveys of the western peripheral

mountain regions were carried out by Sir Aurel Stein (Stein,1931,1967 etc.) and by Walter Fairservis (1950,etc.) Stein reported numerous prehistoric sites, and recovered a vast amount of pottery, lithics and some shell artifacts in the course of his numerous surveys. On the basis of associated finds and stylistic features, most shell artifacts can be dated to the 1st and 2nd millennia B.C., or at the earliest, the 3rd millennium B.C. (Jhelum Valley sites in Stein,1967). However, at the site of Damba Koh in Southeastern Iran, he did discover one example of a wide <u>Turbinella pyrum</u> bangle (unpublished, Dam.II. 8.67, Peabody Museum # 36-91-60/3467), which is similar to the bangles found at Mehrgarh up to the Early Chalcolithic Period. A shell ring was also found at the site, but because of its association with a burial containing iron as well as bronze, it must be from some later period (Stein,1967:Pl.X,Dam.III.18.81; Peabody # 36-91-60/3486).

Just north of Damba Koh, the site of Bampur is extremely important because on its connections with other sites in Southeastern Iran, Baluchistan and even Oman. Unfortunately, very little shell has been reported from the various surface surveys and excavations. Hargreaves (1929:34) only found one shell bangle during his survey, and De Cardi only recovered one <u>Spondylus exilis</u> pendant from Period V, which is dated by ceramic comparisons to the Later Chalcolithic or Protohistoric Period (= Mature to Late Indus) (De Cardi,1970:331, Fig.52).

Further east, at the site of Sohr Damb, Nal, Hargreaves reported the discovery of various barrel-shaped beads and cylindrical beads from pot-burials in areas A, G and from Room F (Hargreaves,1929:28). Unfortunately the chronological context and exact description of these beads has not been recorded, so they can only be roughly dated to the 3rd millennium B.C. and do not provide any comparative evidence for the beads at Mehrgarh.

In the Kalat valley of Southern Baluchistan, just north of Nal, De Cardi excavated part of the site of Anjira. Again, she only recovered a single shell artifact, consisting of a badly preserved bead (De Cardi,1965:101). This meagre evidence comes from levels associated with Period II (= KGM II-III), indicating some trade/exchange of shell through this region during the late 4th to early 3rd millennium.

Not far from the modern city of Quetta, Fairservis excavated a deep sondage at the site of Kile Gul Muhammad, where he found stratigraphic evidence for habitation beginning in the Aceramic Neolithic Period and lasting through the Early Chalcolithic (Fairservis,1956). Due to the limited nature of the excavations, it is not surprising that he found no shell in the lowest levels, but since he does not report any from the succeeding levels, we are left with the impression that the sample is not representative of the material culture of the region during this early period. In his surface surveys throughout this same region, he

collected a few shell artifacts (Fairservis, 1956:230), which are stylistically similar to those found during the Neolithic and Early Chalcolithic at Mehrgarh. At the site of Damb Sadaat, (Q8) he reports one plain shell bangle fragment, one grooved shell ring fragment, two tabular beads and large disc bead from Period II (Fairservis,1956:230, Figs.24,25). The large tabular beads are made from the Turbinella pyrum (American Museum of Natural History #73-3868, -3869; Fairservis,1956: Fig.25,h,i) and the large disc bead is made from an unidentified large gastropod (AMNH #73-3872 ; Ibid., Fig.25,g). Period II levels can be dated on the basis of ceramic comparisons and C14 dates to the 4th and early 3rd millennium B.C.,which would be just prior to the Early Indus period in the plains region (Mughal,1975 ; Shaffer,1978).

Northwest of Kile Gul Mohammad, at the edge of the Kandahar Plain in Afghanistan, lies the important site of Mundigak. Here, Casal found evidence for the development of a major settlement beginning around 4000 B.C.(Period I), continuing through the Chalcolithic to around 2400 B.C. (Period IV) and extending into the late Bronze Age/early Iron Age, 2000-1500 B.C.(Period V)(Casal,1961; Shaffer,1978:115). Shell artifacts have been recovered from all periods at the site, with the most common type being cylinder disc beads. These beads are reported from Period I-3,4,5;Period II-3; Period III-2; Period IV-1,2,3; Period V-2 (Casal,1961:Vol.1:240 243, Vol.2:Fig.138-1,11). Other

types of shell artifacts include less distinctive, irregular short cylinder beads and perforated natural shells. I have not been able to examine the various types of beads so it is not possible to determine whether they are made from a gastropod or a bivalve, but the two pendants have been identified in the report as being Mitra litterata (Lamarck) and Natica aurantia (Lamarck)(Ibid.Vol.2:131-22,24). The dating of each period at the site has been discussed at great length over the past 20 years, and Period III-5 can be fairly reliable placed at 2800 B.C. on the basis of C14 dates and comparisons with other sites in the region (Dales,1973:165,Fig.11.2 ; Shaffer,1978). Ceramic styles and other artifact types from each different period have been related to artifacts at other contemporaneous sites in Baluchistan, Eastern Iran and Central Asia, suggesting the presence of a complex network of trade/exchange (Jarrige and Tosi,1981:115-142). The presence of cylinder disc beads at both Mehrgarh and Mundigak during the Early Chalcolithic is therefore not surprising, but the absence of shell bangles from Mundigak raises some new questions regarding the direction of exchange between the mountains and the plains. First however, let us look at the site of Shahr-i Sokhta.

Situated further to the south-west in Iranian Seistan, this site is located at the crossroads of several trade/exchange routes between Eastern Iran and Baluchistan; between the coastal ranges and Northern Baluchistan, and between Central Asia and Southeastern Iran. Numerous shell

fragments have been discovered at the site, including bangles made from Turbinella pyrum. Durante has published a summary of his analysis, where he discusses the role of Xancus pyrum (= T. pyrum) in the trade and industry of the 4th and 3rd millennium B.C. (1975:27-42). At the end of the discussion he points out that all shell artifacts made from T. pyrum have been found from surface contexts, nevertheless, they have been tentatively dated to Period II and III, from 2800 B.C. to about 2300 B.C. (Durante,1975:42; Tosi et. al.,1981). The basis for this correlation is somewhat unclear, except perhaps their association (on the surface) with diagnostic third millennium types of drilled seals. Durante has identified these seals and similar ones from Tepe Yahya as being made from Turbinella pyrum,(Durante,1975:34, No.125,126 ; 1977:333 ;and Tosi et al.1981:Fig.23,24). But, having examined some of these and other small shell fragments from both sites, I find no definite structural feature on which to base this identification. These artifacts could have been made from any large gastropod, found in the Arabian Sea or the Gulf, particularly the Lambis truncata sebae or Fasciolaria trapezium.

A total of 14 bangles have been reported from Shar-i Sokhta, and all are undecorated. One example is reported as being incised, but it is too worn to determine if this is intentional or a feature of later weathering processes. From the 12 recorded examples, we have the following

statistics:

N = 12 Mean Width = 8 mm sd = 1.6 minimum = 5 mm
maximum = 11.5 mm

Along with the bangles, several sawn and chipped wasters have been found, including the chipped columella of *T. pyrum*. The saw marks on the wasters indicate the use of a copper/bronze saw and range from 1 to 1.2 mm in width. These wasters definitely indicate the manufacture of shell bangles in this area of Seistan, using a tradition similar to that found in the Sindhu/Nara Region during the Early/Mature Indus Period. Compared with the bangle widths from Period III at Mehrgarh, the Shahr-i Sokhta bangles can be considered "thin", and since they are from surface contexts, should be interpreted with due reserve.

Other shell artifacts, such as pendants, beads and seals, were made from *Pinctada*,sp. ,*Engina mendicaria*, *Polinices tumidus*, and some large gastropod. These artifacts can be fairly reliably dated to the Early Chalcolithic, and have well dated parallels at other sites, specifically Tepe Yahya, where shell occurs from the Neolithic levels (Period VI,circa.4200 B.C.) though the Chalcolithic levels (Period IV, 3500 B.C.) (Lamberg-Karlovsky, 1970: Pl.37 ,d,g,i,j, Pl.38,b,c,e; Durante, 1975:27). There is no evidence for the use of *T. pyrum* in the early levels at Tepe Yahya (Period VI & V) and the large gastropod fragments that have been identified by Durante as belonging to *Turbinella pyrum* come only from

Period IV or surface contexts. Again, having examined them personally, I would hesitate to make such an identification because of structural elements common to other locally available gastropods, such as Lambis truncata sebae and Fasciolaria trapezium. Since no columella of T. pyrum, or other definite species indicators have been recovered from Tepe Yahya, it would be premature to discuss the trade/exchange of this species to this distant region during the prior to the late 3rd millennium B.C.

Discussion

Returning now to the discussion of trade/exchange, we are confronted with the question of how shell artifacts and raw shells reached the inland site of Mehrgarh. First, let us look towards the west, where numerous comparative studies have been made on the material culture, production techniques and architectural features of sites in Southeastern Iran, Baluchistan and Central Asia. These studies have resulted in the fairly reliable reconstruction of trade/exchange networks between these regions during the 4th and 3rd millennium B.C.(Lamberg-Karlovsky,C.C. and M.Tosi, 1973 ; Kohl, P,1975). Furthermore, on the basis of ceramic comparisons and the discovery of certain shell species at many of these sites, Tosi has reconstructed the possible access and trade/exchange routes between the Gulf of Oman and the inland regions (Tosi,1976: Fig.1). The important species common to the Gulf of Oman are Engina

mendicaria and Polinices tumidus, and the coastal and inter-site routes follow the major river valleys and plateaus. The site of Mehrgarh can now be linked up with this vast interaction network on the basis of similarities in ceramic styles, the presence of lapis lazuli and turquoise and now, specific types of shell artifacts.

Even though there is little stratigraphic evidence from other sites in Baluchistan and Eastern Iran, we know that shell artifacts were being used in the highlands of Southern Baluchistan during the Neolithic and Early Chalcolithic Periods. Similarities between Mehrgarh and the Baluchistan sites, in terms of ornament styles and shell species, indicates that the major source of shell was from the western portion of the Makran coast, via the western highland interaction network. Furthermore, the absence of definite stratigraphic evidence for the presence of Turbinella pyrum at highland sites prior to the Mature Indus period (2500 B.C.), suggests that the T. pyrum found at Mehrgarh was coming by a different route. The most direct access with the eastern Makran coast would have been down the Sindhu/Nara plain or, along the more rugged piedmont of the Kirthar and Kohistan mountains to the Las Bela Plain (Fig.3-2). Although a few bangles of T. pyrum cannot be taken to represent a major trade of marine commodities, it does suggest that from as early as the during the 7th or 6th millennium B.C., Merhgarh was involved in two different trade/exchange systems; one linked the site to the

Sindhu/Nara plain and the other to the highland plateaus in the west.

Coastal populations exploiting marine resources near Ras Mauri, and Sonmiani Bay were probably collecting T. pyrum and other shells from the shallow bay. Ornaments and bangles made from these shells were undoubtedly distributed through a system of indirect exchange that eventually reached the inland site of Mehrgarh. If these indirect exchanges led to a northen distribution we may also find similar distributions along the coast to the west or in the Central Makran valleys. As of yet we do not have any concrete evidence from these regions , so it is not possible to discuss the presence of a possible seaboard trade during the Neolithic period.

During the Early Chalcolithic at Mehrgarh, Period II, there is very little change in the types of shell artifacts, except for the fact that some shells (i.e.Strombus, sp.) are now being manufactured at the site itself. Various species of Strombus are found all along the Makran coast, and if more fragments are discovered so that the exact species can be identified, we may be able to assign it to one or the other trade/exchange systems.

In Period III, however, we see an increase in the use of T. pyrum and the disappearance of most of the other species used in Periods I and II. The raw shells were probably being brought directly from the coast, by the plains route and then processed at the site. On the basis

of ceramic comparisons, there were still strong connections with highland sites (Jarrige,1979:110-111), but now shell ornaments were being manufactured at the site itself. The predominance of *T. pyrum* suggests that trade contacts within the plains region had gained importance and that now, local craftsmen began importing the raw materials rather than the finished objects. This pattern of increased local production and interaction within the Sindhu/Nara plains region becomes more pronounced in the succeeding periods, until finally, at the end of Period VII, we see the appearance of artifacts and pottery characteristic of the Early Indus Period (Sable, F.,1981:29).

Early Indus Period

Although many earlier scholars had recognised the presence of chronologically older cultural traditions in the Sindhu/Nara Region, Mughal (1970) was the first to recognise some of these as providing a formative contribution to the later Mature Indus civilization. This formative, Early Indus Period saw the development of certain technological and stylistic traditions that continued into the mature urban period, and from the few sites that have provided sufficient samples, we see this continuity in the use and manufacture of shell objects. Due to waterlogging of the lowest levels at most sites on the Sindhu/Nara plain, many sites with potential Early Indus occupations have remained unexplored. Evidence from the lowest levels at both Mohenjo Daro and Harappa, in the form of diagnostic pottery types, shows that even at these large sites there was an Early Indus occupation. Unfortunately, no shell has been recovered from these lowest levels, and we must look at some of the smaller rural settlements for information on early shell working.

Amri

The most important evidence for the development of a Chalcolithic shell manufacturing technology comes from the site of Amri. Situated on a gravel terrace west of the Sindhu Nadi, the site had access to fertile soil of the

alluvial plain, the rich lacustrine resources of Manchar Lake and direct contact with highland environments through the Kirthar Range. Casal's excavations of the two mounds (A and B, about 9 hectares in area) revealed the presence of four major periods (Casal, J.M.,1964). Period I is divided into 4 phases, and represents the earliest habitation of the site during the Amrian or Early Indus Period. The following Period II is a transitional phase leading to the Mature Indus occupation, Period III, phases A,B, and C. At the end of Period III, during phase D, Casal reports a Late Indus occupation on the basis of ceramics relating to the poorly defined "Jhukar" culture. The last proto-historic occupation of the site is identified as "Jhangar", again on the basis of surface collections of ill-defined pottery types (Casal,1964).

During the early habitation in Period I there is a predominance of handmade pottery (80%) and some wheelmade , plain and painted types. The painted designs represent an indigeneous style, referred to as Amrian, which can be related to similar technological and stylistic developments at sites in Baluchistan (i.e. Togau C, Damb Sadaat I and Sur Jangal II). In the later levels of Period I, we see the construction of mud-brick structures and an increase in wheelmade pottery, with new forms that continue into the Mature Indus Period (i.e. dish-on-stand, "S"-form cooking pot, etc.). Numerous copper artifacts have been found, indicating the familiarity with copper metallurgy, yet chert

blade tools still had an important role in agriculture, hunting and possibly other forms of production. This Period can be dated from around 3600 B.C. to 3200 B.C. on the basis of C14 dates and ceramic comparisons with other dated sites (Casal,1964; Dales,1973; Mughal,1975).

In Period II, the site was leveled and new structures built out of mud-brick, but along a slightly different orientation. The ceramics of the earlier period still continue, though there is an increase in styles related more directly to the Mature Indus period. No C14 dates are available for this period, but it can be bracketed by dates for the Mature phase to somewhere between 3200 and 2500 B.C.

Shell artifacts have been reported from all four phases of Period I, but due to problems in relating specific levels from different areas to the chronological phases, I have grouped all recorded artifacts from Period I together. Before going on it is necessary to explain the source of my data. The largest collection of shell artifacts from Casal's excavations (92 examples) is in Pakistan at the Department of Archaeology, Karachi. I was able to study another smaller collection at the National Museum of Oriental Art, Rome, which was on loan from the Musée Guimet, Paris. The third source of information comes from the original excavation report and the analysis made by Robert Soyer (Casal,1964:Vol.1).

In Period I, marine shell was used in the manufacture of beads, pendants, bangles and also small rings. Shell

beads are not very numerous, but one irregular cylinder disc bead is published (Casal,1964:Vol.2,Fig. 122,6). Pendants made from perforated natural shells appear to have been quite common, and all species represented are found on the Sindh and Eastern Makran coasts, some 200 km to the south (Table 3-5). It is interesting that there are no examples of Pinctada sp. or of Engina mendicaria from Amri, and for the first time we have stratigraphic evidence for the use of Polinices tumidus in Period I,B. In the excavation report, several examples of Nerita albicilla and N. polita have been identified, but the illustration of a "Nerita" pendant (Ibid.; Fig.120,12) looks more like Polinices sp. However, both species of Nerita are quite common along the Western Coast and this minor discrepancy need not discount the presence of this species at the site.

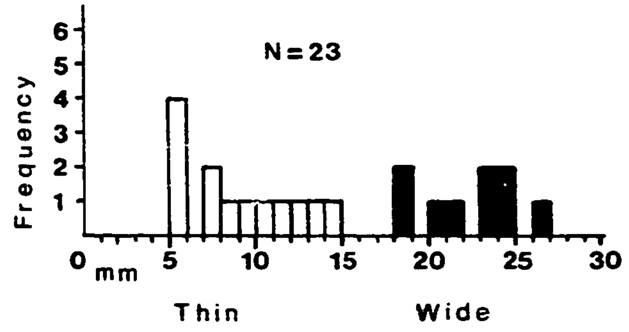
Another reported taxa that I was unable to locate in either collection is the bivalve Cyrena (or Velorita), which occured in a large midden in Mound A, Period IA,level 32 (Ibid.,p. 49, Fig.D). Although Soyer does suggest that this Genus is possibly estuarine, it is most commonly represented by fluviatile and lacustrine species. The estuarine species most common to the coasts of India are Velorita cocchinensis (Hanley,1858) and Velorita cyprinoides (Gray,1825) (Preston,1915:206-211). Because of the supposed marine source of the shells in the midden, Casal thought that the coast may have reached much further inland, possibly near to the site itself (Casal,1964;171).

As has been discussed above, the Sindhu/Nara delta began a rapid build up in the late Pleistocene and there is no evidence for estuarine conditions near the site during the 4th to 3rd millennium B.C. In view of the fact that the stable coast is 150 to 200 km south of the site and that Lake Manchar and the ancient Sindhu river were both accessible from the site, I would venture to suggest that the shells in the midden were fresh water and not "marine". In his analysis of the frequency of fresh water to marine species during each period, Soyer found that there were more marine species in the early periods and less in the latter periods. Although I do not have access to the specific artifact counts used by Soyer, my assumption that the _Cyrena_ sp. found in Period IA are freshwater, would completely reverse his frequencies and interpretations (Casal,1964,Vol.1:171).

TABLE 3-5. AMRI: SHELL ARTIFACTS, PERIOD I.

Artifact Type	Species	Mound A	B
BEAD, Cylinder Disc	species ?	X	
PENDANT,Natural Shell	_Nerita_,sp.	X	
	Tibia insulaechorab	X	
	Polinices tumidus	1	
	Natica lineata	1	
	Conus, sp.	2	
	Cypraea, sp.	X	
BANGLES, plain	_Turbinella pyrum_	20	3
RINGS,unfinished	_Turbinella pyrum_	2	
, finished	_Turbinella pyrum_	3	1
Manufacturing Waste, Chipped and Ground	_Turbinella pyrum_	2	
Unworked Shell	_Cyrena_ sp.	X	

TABLE 3-6. AMRI: SHELL BANGLE WIDTHS, PERIOD I



Shell bangles made from Turbinella pyrum are the most significant ornament at Amri, because of the stylistic and technological changes seen in each period. A total of 23 bangles (having provenience and level numbers) have been recorded from Period I and none of the fragments show any form of decoration (Fig.3-3;6,7,9,10). All of these bangles are finished and some of them have been repaired by drilling holes to rejoin the broken fragments. In terms of bangle widths, we see a rough bimodal distribution (Table 3-6) indicating the manufacture of both thin (5 to 14 mm) and wide (18 to 26 mm) bangles. Only two fragments of possible manufacturing waste have been recorded from Period I. Both pieces are chipped from the body whorl of T. pyrum, and one of the fragments has been denticulated on one side and ground on the other. The denticulated edge shows heavy wear, suggesting that it was used as some sort of scraper. On the basis of these two fragments it is not possible to determine the amount of manufacturing going on, but two unfinished rings (Fig.3-3;12,13) do indicate that some manufacturing was being carried out at the site. As was

pointed out in the discussion of bangles from Mehrgarh, Period III, the different widths of the bangles may represent two different manufacturing traditions rather than different styles. One tradition can be seen as a Neolithic one, where a single wide bangle was made by chipping and sawing with a chert blade. The other is purely Chalcolithic, where several bangles were produced by sawing with a copper/bronze saw. On some of the thin bangles from Amri, there are faint traces of regular parallel striae that could indicate the use of a copper saw, and furthermore the width of each bangle is fairly uniform. On the other hand, the wide bangles have irregular edges and the width of a single bangle varies considerably. These factors can be combined with the fact that they are extremely worn, and that some have been repaired may indicate that they were made at a much earlier time using an earlier technology (Fig.3-3;9,10).

A new artifact that appears for the first time at Amri, are small rings, presumably finger rings. These are all made from T. pyrum, some from the spire of the shell (Fig.3-3:12) and others from the thick body whorl (Fig.3-3;13). As was mentioned above, two of these fragments were unfinished, indicating that they were being manufactured at the site.

From Period II, only two shell bangles have been recorded, and both of these are of the thin variety (2.4 and 3 mm in width, APPENDIX III:2).

In view of the range of species found at the site, the most likely source for these shells would have been the nearby coastal region around Ras Mauri and Sonmiani Bay. All of the represented species are quite common along this coast, including the important Turbinella pyrum. The absence of Lambis truncata sebae, Chicoreus ramosus and Fasciolaria trapezium would imply that there was no contact with the coastal regions east of the Sindhu/Nata Delta, or with the Oman coast where these species are quite common. Furthermore, the absence of Pinctada, sp. and Engina mendicaria would suggest that no shell artifacts were coming to the site through the Baluchistan trade/exchange system.

Balakot

Although the early occupation at the site of Balakot does not fall into the category of Early Indus settlements as defined by Mughal (1970), it does provide an important sequence of adaptation to a coastal environment prior to the Mature Indus Period (Dales,1979 ; Meadow,1979). The site is about 2.8 hectares in area and is characterized by a small mound (9.7 meters meters above the plain level) and a lower habitation area to the east. Situated on the alluvial plain of the Windar River it is presently about 18 kilometers from the open sea coast. Some eight kilometers west of the site is the shallow, brackish Siranda Lake. Occasionally, when this lake fills with monsoon flood water, it has been reported to overflow to within four kilometers of the site

(circa 1920, local informants). It is possible that the lake may represent an ancient estuary of Sonmiani Bay that has now been cut off by silting, windblown sand and probably local tectonic activity. Although these various factors have resulted in some changes in the topography, it is not likely that the site was directly on the coast during the 4th and 3rd millennium B.C. (Meadow,1979:275-280; Snead and Erickson,1977).

The earliest levels of the site are six meters below the present plain level, and represent the pre-Indus or Balakotian (Period I) occupation. Three C14 samples from the upper levels place this occupation in the 4th millennium B.C. (around 3500 to 3000 B.C., uncorrected dates, Dales,1979). These dates are supported by ceramic comparisons with other 4th millennium sites in Baluchistan (Nal, Togau C) and also with Amri , Period I (Dales,1979; 49-50). Period I has only been partly exposed, and quantitative comparisons cannot yet be made because the analysis of the artifacts and stratigraphy is not yet complete. A preliminary estimate of the total excavated area for the latest occupation of Period I is 1.4%, while that of the latest Indus occupation is about 73% (Dales,1979:48).

In Period I the inhabitants lived in mud-brick structures with thick mud pavements; they used chert blade tools and some copper implements; and they produced their own pottery using both slow and fast wheel techniques. The

presence of grinding stones, gloss on the edges of chert blades and preliminary studies of floral remains (McKean,P.,1983) indicate the practice of limited agriculture. Most of the subsistence appears to be oriented towards livestock, with is evidence for the herding of cattle as well as sheep and goats (Meadow,1979:287). Even though the final analysis of the faunal material has not been completed, the relatively few examples of fish bone and shell, suggest that marine resources were not heavily exploited by the early inhabitants of the site, but they were definitely familiar with marine resources. A wide range of marine and estuarine mollusca have been recovered from most levels of Period I and their occurrence indicates the exploitation of molluscs for food and also a limited amount of shell working.

TABLE 3-7. BALAKOT, MARINE SHELL ARTIFACTS, PERIOD I

ARTIFACT TYPE	SPECIES	PERIOD I	I & II
Bead/Pendant, Perforated Shell	Nerita, sp.	1	
	Tibia insulaechorab	1	
	Polinices tumidus	5	1
	Natica, sp.	1	
	Oliva, sp.	7	
Bangle, Plain	Turbinella pyrum	2	
Manufacturing Waste, sawn	Turbinella pyrum	1?	
,ground columella	Turbinella pyrum	2	
Shell, Hollowed	Telescopium telescopium	2	
Shell, Unworked or Fragment	Umbonium vestiarium	2	
	Nerita polita	1	
	Turritella torulosa	2	
	Telescopium telescopium	4	
	Terebralia palustris	2	
	Tibia insulaechorab	8	
	Erosaria turdus	6	
	Peribolus(A.)grayana	4	
	Polinices tumidus	18	2
	Natica lineata	7	
	Thais, sp.	1	
	Oliva bulbosa	1	
	Oliva sericea	1	
	Dentalium octangulatum	1	1
	Anadara granosa	3	1
	Anadara sp.	4	
	Anadara antiquata	6	4
	Spondylus exilis	2	
	Placuna placenta	1	
	Crassostrea madrasensis	3	
	Saccostrea culcullata	1	
	Cardita bicolor	1	
	Cardium assimile		1
	Tivela damaoides	1	
	Meretrix ovum	7	
	Callista impar	4	
	bivalve, species ?	4	

All species listed above occur along the coasts near the site, some in rocky habitats, some from sandy bays and

others from backwaters or estuaries. Very little shell working is seen in Period I, and all of the beads or pendants have been made by simply perforating the natural shells. Some of the perforations were made by a pointed tool (Nerita, Natica, Tibia, Polinices,sp.), and others by grinding (Oliva,sp.). Till now, a total of five artifacts made from Turbinella pyrum have been recovered from levels associated with the Period I occupation. Two rounded cylinders were found in Phases IX and VII (Dales,1974:8) and these were made by chipping and grinding the thick columella. What their use might have been is not certain as they have not been perforated. From Phase VIII, a single bangle fragment has been recovered, and another wide bangle was found in the excavations of the final season. This last bangle is 24 mm in width and the broken edges have been ground to form an irregular disc, again for some unknown purpose. Only one sawn manufacturing waster has been discovered (Phase IV) , but it is does not show any striae that could help in determining what type of tool was used to saw it. The presence of these artifacts and the sawn fragment, indicates that there was an early tradition of shell working at Balakot that predates the full development as seen during the urban Indus period. Further analysis of the faunal material and horizontal excavations will hopefully provide more information regarding this industry.

The remaining shell artifacts are all of unworked or broken shell fragments. Some of the examples are heavily

rolled, and have obviously been collected dead on the beach, but others are in fresh condition and suggest the intentional collection of live molluscs. The fragmentary state of some of the spiraling estuarine gastropods, such as Terebralia palustris and Telescopium telescopium probably indicates smashing to remove the meat. This practice is well documented in the later Period II, where both species were consumed in large quantities (Meadow,1979).

On the basis of this preliminary analysis, it is evident that although the main adaptation was towards animal husbandry and agriculture, there was some marine exploitation. The presence of lapis lazuli and agate beads during Period I, demonstrate that Balakot was involved in a larger inland trade/exchange sphere, and therefore many of the shell artifacts at contemporaneous inland sites may have been collected by the inhabitants of Balakot and other undiscovered coastal sites.

Other Early Indus Sites

Evidence for shell use and shell working at Early Indus sites is extremely poor, but a few other sites do provide some important comparative data. At Kot Diji, the "type site" for the Early Indus Period, Khan (Khan,F.A.;1965) found a long sequence of habitation prior to the Mature Indus period. The site is situated on a rock outcrop east of the Indus River, and during the early occupation it was fortified by a rubble wall. The total area of the site

during the Early Indus period has not been determined, but during the Mature period it was about 2.25 hectares in surface area. In his first report, Khan noted a sharp decrease in "minor antiquities" in the early levels of the site, with "only a few objects of shell and bone" (1964:43), but in the more complete excavation report he did not describe or elaborate on the types of shell artifacts found from the Kot Dijian levels (Khan,1965). While studying the shell objects at the Department of Archaeology in Karachi, I was able to record 12 shell bangles and one chipped and ground columella fragment, all from the marine gastropod Turbinella pyrum. These artifacts come from levels 4 to 6, which represent the end of the Kot Dijian occupation just prior to the Mature Indus Period at the site. All of the bangles are of the thinner variety (Table 3-7a) and two examples have a single diagonal incised line covering the natural suture of the shell.

TABLE 3-7a: KOT DIJI, BANGLE WIDTHS, LEVELS 4-6

N= 12	mean width = 5.1 mm	sd = 2.8	minimum = 2.6 mm
			maximum = 12.5mm

No unfinished bangles have been recorded, and since there is only one partly ground columella, it is difficult to discuss the manufacture of shell at the site. As at Amri, Period I we can suggest that the thin bangles indicate a technology using a copper/bronze saw, rather than chipping

and grinding. Chronologically, however, the occurrence at Kot Diji is much later, around 2700 B.C. No other shell artifacts have been recorded from the Kot Dijian levels, and the proximity of this site to the major urban center of Mohenjo Daro suggests that these bangles represent the full development of the bangle manufacturing tradition just at the beginning of the Mature Indus Period.

The site of Gumla is situated on the Gomal River, just at the western edge of the Upper Sindhu/Nara plain. Excavations have revealed a long sequence beginning in the Neolithic or early Chalcolithic period, during the 4th millennium B.C. No shell has been reported from the Neolithic or Early Chalcolithic Periods (Gumla I &II), but in the Early Indus Period (Gumla III) one shell bangle was discovered (Dani,1970-71:88). This single bangle fragment is decorated with five parallel grooves that result in six prominent ridges. Similarly decorated bangles made in red or black terracotta are reported from Period II, II and IV (Mature Indus), but no other shell bangles with this type of design have been reported from other contemporaneous sites. The only other parallels are from the site of Surkotada, in Kutch, and these come from the Late Indus period (see below). On the basis of this single bangle fragment, it is not possible to discuss anything about technological developments or trade/exchange contacts during the Early Indus Period. A similar lack of information is also

encountered at the site of Sarai Khola.

This site is situated just at the northern edge of the Indus valley, near a small tributary of the present Indus river. The lowest levels at the site represent a Neolithic adaptation, but are dated to around the late 4th millennium B.C. (cf. Mughal, in Halim,1972:37,footnote 7). No shell had been recovered from these levels, but in the following Early Indus levels, (Period II), one shell bangle and 10 shell beads were found (Halim,1970-71:29-31). Period II is dated , again by ceramic comparisons with Kot Diji, to around 2800 2700 B.C.(Ibid.). I was unable to examine any of the beads, but the illustrations show two types; a long tapered barrel bead and a short elliptical bead (Halim,1972:23,Fig.IV,13,14). The long bead (41mm) was possibly made from the thick columella of Turbinella pyrum, while the flatter eliptical bead was probably made from the thick body whorl of some large gastropod. Neither of these forms have been found at other Early Indus sites, but they do occur in the Mature Indus levels at Mohenjo Daro and numerous other sites. I was able to examine the one shell bangle , and on the basis of its width (5.5 mm) and the parallel sides of the cut edge, it appears to have been made by a well developed technology using a copper/bronze saw (Fig.3-4:1). The finely ground and faceted exterior edge of the bangle is a feature common on Mature Indus bangles and is not seen in the early period. There is no evidence for the manufacture of shell objects at the site and these few

pieces may indicate contact with Mature Indus sites prior to the abandonment of the site at the end of period II.

Kalibangan is one of the few excavated sites located on the ancient Nara Nadi system that could provide some interesting data regarding the use of shell in the northeastern regions. Unfortunately, no detailed descriptions of the shell materials have been published and I was unable to examine any of these artifacts personally. The presence of shell bangles has been reported from the Early Indus or Sothi levels, and a single illustration (IAR,1962-63:20-31, Pl.LXII,B) would indicate that they are of the thin variety. There is no mention of any shell manufacturing waste from either the Early or Mature Indus occupations, so further discussion is not possible until the the artifacts have been properly analysed.

Although there is sufficient evidence for the use of shell in the Lower Sindhu/Nara region and the Western Coast, there is little information from the Eastern Coastal regions of Kutch and Kathiawar. The site of Rangpur has the earliest sequence in this region, with "Microlithic"" levels (circa 3000 B.C.) below the Mature Indus occupation, but no shell was found in these levels (Rao, S.R.,1962-63:15). Again, at the site of Lothal, the only occurrence of shell is in levels containing other definite Mature Indus artifacts. The excavator , S.R.Rao, reports that shell

bangles occur in the earliest excavated levels at the site (Phase I, circa 2450 B.C.), but due to waterlogging it was not possible to excavate down to virgin soil (Rao,1973:54). In Phase I, most of the pottery is made in an indigeneous style using a highly micaceous clay (Micaceous Red Ware), but some Mature Indus forms are also present. It is possible that the local inhabitants used shell prior to the advent of the Indus traditions, but no chronologically earlier sites have been found yet to demonstrate this.

Summary

In summary, evidence for the development of a chalcolithic tradition of cutting shell with a copper/bronze saw comes primarily from sites in the Lower Sindhu/Nara region. These sites had more or less direct access to source areas for _T.pyrum_ and other smaller species along the Western coast, and since the other large gastropods, particularly _Chicoreus ramosus_ are absent, we can assume that they were not using the resources of the Gulf of Kutch. Furthermore, the lack of shell at the Early Chalcolithic sites in the Upper Indus region and its paucity during the Early Indus period may indicate that the sphere of coastal trade/exchange was limited to the Lower Sindhu/Nara Plain and the peripheral region of Southern Baluchistan. The discovery of a second major source of lapis lazuli in the Chagai Hills means that the lapis lazuli at Early Indus sites did not necessarily come from northern Afghanistan.

This new development would rule out the implication of long distance trade between the Lower Plain and the northern peripheral regions. In view of the very limited amount of shell in the Early Indus sites to the north, and the fully developed stylistic features of the shell artifacts, it is suggested that these sites became involved in contact with the southern region only just prior to the Mature Indus period. This north-south division has already been noted in the dominant Kot Diji and Sothi ceramic styles at sites in the northern regions, in contrast to the Amri and Kulli related styles in the Southern region (Mughal,1970). Now we see that this separation of interaction spheres is also reflected in the lack of trade/exchange in marine commodities such as shell.

Mature Indus Period

Mohenjo Daro

Moving now to a discussion of the shell industries of the mature urban phase of the Indus Civilization, we see a major change in the use of marine shell as a raw material. No longer is it used to make just ornaments, such as beads and bangles, but rather, to produce a vast range of decorative, ornamental, utilitarian and possibly ritual objects. The largest collection of shell artifacts from this period comes from the site of Mohenjo Daro. The site has been extensively excavated but we still do not know its full extent. On the west is a high mound referred to as the "citadel" and to the east and south are extensive lower mounds called the "lower city". A general estimate of the total area is around 85 hectares, but by including the outlying lower mound to the northeast, the circuit of the site would be more like 7 kilometers rather than the 5.6 km (3.5 miles) estimated in the past (Marshall,1931; Mackay,1938).

This major urban center was situated on a low ridge in the middle of the Lower Sindhu/Nara plain, about 325 kilometers from the Western coast and about 550 km from the southern shore of the Gulf of Kutch. In this location, it had access to the major communication and trade routes

connecting the Western and Eastern coasts with the Upper Sindhu/Nara region, and the Lower plain with the western mountain regions.

I have been able to study over 2800 artifacts that have been recovered from excavations and surface collections at the site during the past 60 years (Appendix III:4,III:5). Because of the different contexts from which these artifacts come, it is first necessary to explain the nature of the samples to be discussed below. Most of the artifacts come from the early excavations made by Marshall and Mackay during the 1920's and 1930's, and have been recorded in the original field registers. Through a detailed study of the register entries I have been able to tabulate 3376 different shell artifacts. In the course of my research, I was able to record about 2300 shell artifacts from these excavations (68% of those recorded in the registers, including freshwater species). But in comparing the records of the field registers with the corresponding artifacts that I was able to locate, I found numerous discrepancies in terms of the description and identification of these objects (Appendix III:8). Because of their unreliable descriptions, I have not included the sample recorded from the field registers in the present discussion. Unfortunately, these "unreliable" registers are also the only source for determining the provenience from which the artifacts were recovered. With reference to most areas of the site, HR, VS and DK, all shell artifacts can be assumed to belong to the

Indus Period occupation, but in DM and SD areas on the Stupa Mound, some of the levels are related to the Buddhist Period occupation. It has not been possible at this point to determine if some of the levels recorded in the registers relate to the Buddhist occupation (A.D. 150-500, Marshall,1931:122), or the Indus Period occupation. Eventually we hope to be able to sort some of these problems out through the reanalysis of the architecture, but until then, I have decided to exclude the tabulation of all shells from DM area and include all the artifacts from SD area. Although there is are definitely Indus Period objects in the DM sample and possibly some Buddhist Period artifacts in the SD sample, I think that any possible skewing of artifact frequencies, particularly of bangle measurements, will be balanced out by this arrangement. I have not been able to examine any of the shell artifacts recovered from Wheeler's excavations, but artifacts from Dales' excavation have been studied and are included along with the other artifacts from excavated contexts. Due to restraints in time and finances, it has not been possible to complete the distributional analysis of the different types of artifacts within the site, and consequently all excavated artifacts have been grouped together. This shortcoming can fortunately be balanced by the inclusion of a detailed surface analysis conducted in 1981-83 in cooperation with the German and Italian Project at Mohenjo Daro, directed by M.Jansen and M. Tosi. This entire collection has been studied separately in

order to compare the types of artifact patterns revealed from surface collections with those from excavated contexts. Although the earlier excavators have discussed the artifact types at the site in terms of Early, Intermediate and Late periods, the lack of stratigraphic correlations have made it necessary to lump all shell artifacts together and regard them as representing the full range of variation during the Mature Indus Period. In the past, all discussions of Harappan or Indus culture have used Mohenjo Daro as the type site, and all artifacts comparable to Mohenjo Daro types were considered as being "true" Indus Period artifacts. The object of the following descriptive section is not meant to provide another set of such types, but rather to illustrate the different stylistic and technological traditions within this large urban center. With this reference point, we can more reliably isolate regional variation at other urban and rural sites

The Shell Industry

Although the site of Mohenjo Daro is far inland, a wide range of marine mollusca are represented in the total sample (Appendix III:4). As in the Early Indus Period, some of the smaller, colorful gastropods were used as beads or pendants, by simply perforating them. All of the species used for making these simple ornaments at Mohenjo Daro were also commonly used during the earlier period at other sites in the lower plain (i.e.Oliva, Polinices tumidus,Cypraea, etc.

Appendix III:5). Their presence at the site may represent the continuation of earlier traditions, or the presence of rural people who still wore the older forms of ornaments. Most of these species come from the eastern or western coast in general, but some species,i.e. Pinctada and Engina mendicaria may have been brought from further west along the Makran coast. These simple ornaments are relatively uninformative when it comes to technological and stylistic developments and in the following discussion we will be concerned only with those species that were modified to produce artifacts different from the original shape of the natural shell. Only a few of the larger gastropods could be used in this manner, and whereas most of the smaller species occur all along the Western and Eastern coasts, these larger gastropods can be traced to more specific localities.

TABLE 3-8: MOHENJO DARO: MAJOR GASTROPODA AND THEIR SOURCE AREAS.

SPECIES	SOURCE AREA	FREQUENCY
Turbinella pyrum	Western Coast, near Ras Muari	common
	Eastern Coast, Gulf of Kutch	common
Chicoreus ramosus	Western Coast,	rare
	Eastern Coast, Gulf of Kutch	common
	Oman Coast,	common
Lambis truncata sebae	Western Coast,	rare
	Eastern Coast, Gulf of Kutch	common?
	Oman Coast,	common
Fasciolaria trapezium	Western Coast,	uncommon
	Eastern Coast, Gulf of Kutch	common?
	Oman Coast,	common
Pugilina buchephala	Western Coast,	common
	Eastern Coast,	common

The presence of these indicator species at the site demonstrates a radical change in the exploitation of marine resources and the expansion of inland contacts with coastal regions. During the Early Indus Period, marine exploitation

for inland trade/exchange was restricted to the eastern part of the Makran coast. Now, we see the continued use of this source area on the Western Coast, with the addition of the Gulf of Kutch on the Eastern Coast and possibly the coast of Oman. The reasons for including the Oman coast is not readily evident from the shell species from Mohenjo Daro alone, since all of them also occur in th Gulf of Kutch. However, as will be discussed below, neither F.Trapezium nor L.truncata sebae were being used in the shell industries of the Eastern sites, so it is possible that they were being brought from the Oman coast.

In order to study the different types of artifacts being made from these shells, I have grouped them into eight general categories on the basis of important morphological variables relating to stylistic, technological and possible funtional features. Within each of these general categories, there are numerous specific artifact types that have been listed in Appendix II:3.

1) Finished Ornaments
2) Unfinished Ornaments and Manufacturing Waste
3) Finished Utensils
4) Unfinished Utensils and Manufacturing Waste
5) Finished Inlay
6) Unfinished Inlay and Manufacturing Waste
7) Other Special Objects
8) Unfinished Objects and Manufacturing Waste

ORNAMENTS

The most common shell ornament at Mohenjo Daro is represented by shell bangle fragments (35.1%; Table 3-12), which were produced almost exclusively from *T. pyrum*. On the basis of a detailed analysis of manufacturing wasters and partly finished artifacts, it has been possible to reconstruct the major manufacturing stages and the types of tools used.

First, the shell was prepared for sawing by hollowing out the interior and breaking the thick columella (Fig.3-6;a-f). A stone or metal hammer was used to perforate the apex and then a metal pick (or hammer and punch) was used to break the internal septa. Numerous copper/bronze chisels or punches have been recovered from the excavations, and some of these could have been used for shell manufacture (Marshall,1931,Vol.1:501 ;Vol.3: Pl.CXXXVII,8,12, Pl.CXXXV,11-16). Once the shell had been hollowed out in this manner, it was sawn at a diagonal to avoid the aperture and remove the irregular anterior portion(Fig.3-6;g-i). The remaining hollow spire was then sawn into rough circlets of the desired width (Fig.3-6;j-k). These circlets were ground on the interior using a cylindrical piece of sandstone or some other type of abrasive tool, while the exterior was probably ground on a flat sandstone slab(Fig.3-6;m,n).

Most of the finished bangles have an incised design carved into the shell at the point where the suture joins

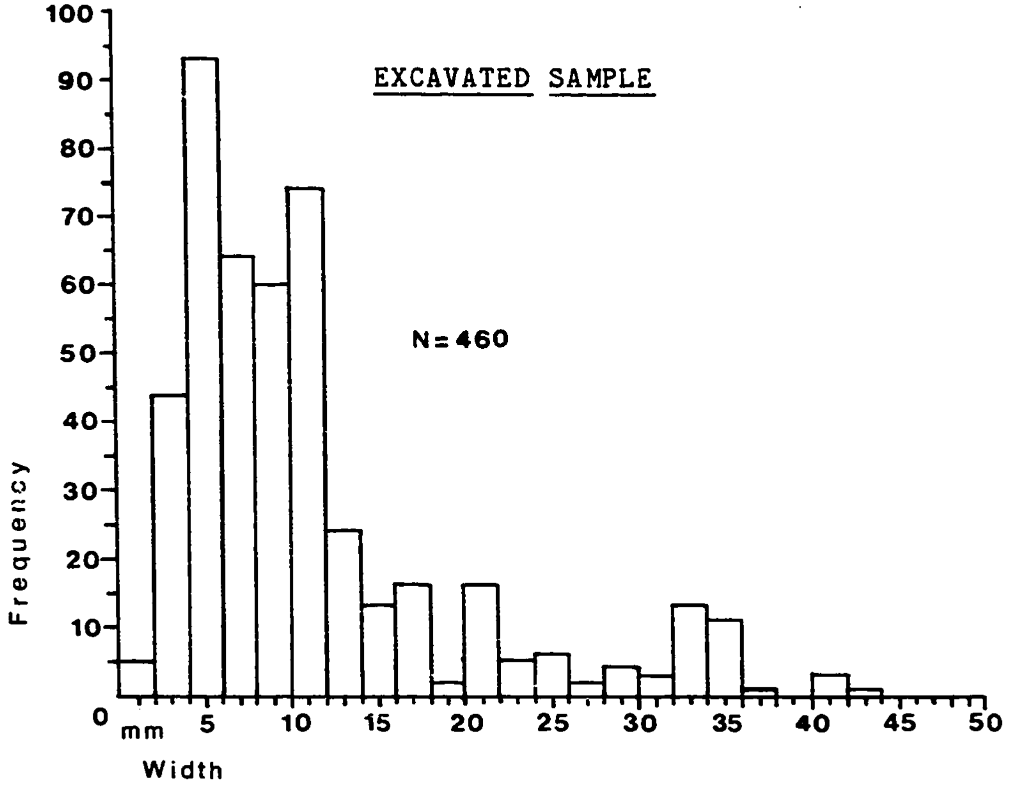
the whorls together (Fig.3-6; o). The motif is generally in the form of a chevron, "V", which very neatly transforms the natural irregularity of the shell circlet into an attractive design (Fig.3-10;1,2,3). During the surface survey, one unique bangle fragment was discovered with a single Indus script character inscribed over the more common chevron motif (Fig.3-10;1). This is the only example of script occuring on a shell bangle, and could indicate a specific socio-ritual use of this specific bangle.

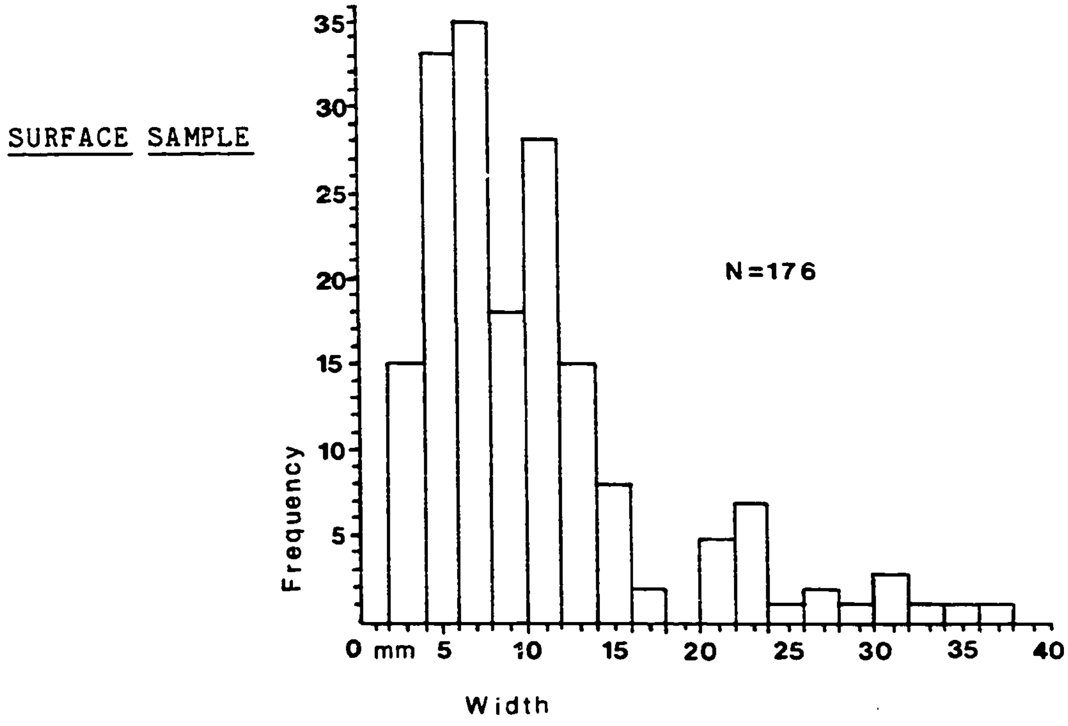
The most common bangle form has a faceted or peaked exterior face, forming a rough triangular section (Fig.3-10;3,7). On extremely worn examples the exterior is slightly rounded, rusulting in a plano-convex section. Wide bangles are generally treated in the same manner, but due to the width, the facts tend to be slightly concave (Fig.3-10; 9,10). No grooved bangles have been discovered from any of the excavated areas of the site, but 10 fragments have been recorded that apparently came from surface contexts (no register number is recorded). These grooved bangles have anywhere from one to three parallel grooves (Fig.3-10;11) and can probably be assigned to the Buddhist Period occupation, as this design is quite common during the later historical periods (see Chapter IV).

A comparison of bangle widths shows a wide range of styles, from thin to extremely wide bangles; 2 mm to 44 mm (Table 3-9). During the Indus period the variation in width is definitely a stylistic feature and can no longer be

attributed to a difference in manufacturing traditions, because we now have evidence in the form of unfinished bangles and manufacturing waste indicating the productuon of wide bangles using a copper/bronze saw. One result of this use of a metal saw is the less distinct division between thin and wide bangles, which were more clearly differentiated in the earlier periods. However, we still see a rough bi-modal (or even tri-modal) distribution (Table 3-9), but it is difficult to determine where to divide these for stylistc classification. The thin bangles can be tentatively divided into two sub categories, those having widths of 2 to 8 mm, and those from 8 to 18 mm wide. The wide bangles are much more varied, ranging from 20 to 44 mm in width, but there are concentrations between 20 to 25 mm, and 32 to 35 mm. Analysis of the bangles in relation to their spatial distribution at the site would provide an additional variable that might determine if certain types of bangles were being worn/discared in specific parts of the city, but until this study has been completed, we must work with these less defined groupings.

TABLE 3-9. MOHENJO DARO; SHELL BANGLE WIDTHS.





Getting back to the manufacture of these ornaments, the incised design could have been made using a chert blade or a more specialized copper/bronze file, and a study of the striae suggests that both types of tools were used. Sawing, on the other hand, was not done with stone tools, as has been suggested by scholars in the past, but by a highly specialized form of copper/bronze saw. A detailed study of sawing wasters indicates that the saw had a long convex edge that was extremely thin; approximately .4 to .6 mm (Appendix III:9). Usually, this saw was only needed to cut through the thickness of the shell body wall, about 5 to 7 mm, but the maximum recorded depth to which the saw could cut is between 20 and 30 mm. The section of the saw edge is generally slightly rounded, and the cutting striae indicate that the saw was bi-directionally denticulate, cutting equally well with each thrust as it was moved back and forth. The maximum distance between each cutting stria is approximately .5 mm indicating the efficient cutting ability of the saw (Fig.3-24;3). There is no evidence in the configurations of the cutting striae to suggest that any form of abrasive was used in the sawing process. Several convex saws have been recovered from the earlier excavations, but none of them fit the requirements indicated by the shell wasters (Marshall,1931,Vol.2:500-501; Vol.3:Pl.CXXXVII,6,7, Pl.CXXXVIII,4,8). The only ethnographic example of a similar saw is the large crescent saw used by modern shell cutters in West Bengal and Bangla

Desh (Chapter IV, Fig.4-1;2).

In addition to T. pyrum, two other species, Pugilina buchephala and Chicoreus ramosus were also occasionally used for manufacturing bangles (Fig.3-10;5) . It is usually difficult to determine the species of a shell from a small bangle fragment, but if the shell suture is present one can distinguish bangles made from T. pyrum (thick , heavy) , from those made from C. ramosus (thin, twisted). Out of 658 bangle fragments from the total sample (excluding DM Area), only 24 (3.6%) were made from C. ramosus.

Other ornaments made from shell include various sizes of rings, beads, perforated discs, pendants, buttons, etc.(Fig.3-11;5 to 18 ; Fig. 3-14; 10). Again, it is often impossible to determine which species of shell an object was made from unless it portrays characteristic structural features of the original shell. On the basis of this type of evidence, it appears that rings were generally made from the spire portion of the T. pyrum, and perforated cylinders from the columella; while the remaining beads, pendants, etc. could have been manufactured from any of the larger gastropods. These objects were produced by various processes of chipping, sawing, grinding and drilling. Many of the circular pieces (Fig.3-11;27) were made using a tubular drill, which was probably made of copper/bronze. The thickness of the tube edge was approximately .9 mm, but the diameter varied according to the size of the disc beiong produced (Appendix III:9). Smaller perforations were

undoubtedly made by tiny chert drills using a standard bow drill. Replicative experiments by the author using chert drills, have shown that a piece of shell 3 mm thick can be perforated in about one minute.

UTENSILS

The most important type of "utensil" found at Mohenjo Daro is the distinctive shell ladle or spoon, made from <u>Chicoreus</u> <u>ramosus</u>(Fig.3-7 ;Fig.3-13;1). It is interesting that no other shell was ever used to make this type of ladle, even though it required an unproportionate amount of labour to produce. Before the body of the shell could be cut, all of the exterior spires and varices had to be first sawn or chipped off (Fig.3-7; a-b). Then, a diagonal cut was made from the top of the main whorl extending around both sides of the shell and eventually reaching the narrow anterior end of the shell (Fig.3-7; c-d). A handle was formed by making two parallel, longitudinal cuts extending from the anterior tip towards the main body whorl (Fig.3-6;e). In this manner, a rough ladle was detached from the body of the shell, and by repeating the process on the remaining half of the shell, a second, but smaller ladle could also be produced (Fig.3-7;d,e). These rough forms were then ground smooth and polished, but due to the irregular nature of the exterior surface, traces of the natural shell are usually visible on the exterior of the finished ladle (Fig.3-7;f) Another apparent defect in the

ladles are the numerous holes left by burrowing organisms. Some of these holes actually perforate the body of the shell and were presumably stopped up with some sort of plaster to make the ladle functional. However, it is not quite certain what this function was. Fragments of finished and even complete ladles have been found throughout the site and it is evident that they were used in habitation areas, either for domestic or ritual purposes. A considerable amount of time and energy was required to produce these objects and it is unlikely that they were easily obtained or used by the average individual for domestic purposes. This idea is further substantiated by the discovery of identical clay replicas (Marshall,1931:471,Pl.CXXXIII,12).

INLAY

Due to the small size of most inlay pieces,it is often impossible to determine the species of shell used to make a particular piece, but a study of the shell wasters indicates that all of the large gastropods were used in the production of inlay. Waste fragments of *T. pyrum* left from bangle manufacture were recycled to make various flat geometric designs. *Chicoreus ramosus* fragments were also reused, but it is interesting that on the evidence from the types of manufacturing waste recovered throughout the site, *F. trapezium* appears to have been used solely for the manufacture of inlay (Fig.3-9). Numerous examples of this shell have been found where only the thick body whorl was

removed by chipping or sawing, leaving the columella and spire as waste. The large pieces of body whorl were sawn, chiseled ,drilled and ground to produce various geometric shapes (Fig.3-11;19 to 35, Fig.3-14;6 to 9). Another species, Lambis truncata sebae, was used primarily for making exceptionally large, solid plaques(Fig. 3-8; Fig.3-12;11). The outer lip was sawn into thin sheets or planks, that could then be cut into the desired designs. Saw marks on many of the inlay wasters, especially those cut from the Lambis, appear to have been sawn by a saw having a fairly flat cutting edge . This saw was also bi-directionally denticulated, but the saw cuts are slightly thicker, indicating that the saw edge was about .7 mm thick (Appendix 3:9).

Very few of the other types of shell fragments at the site show evidence of burning, but quite a large number of burnt inlay pieces have been recorded. Possibly these pieces were set into wooden funiture or paraphernalia that was later discarded or accidently burned. In Mesopotamia there are numerous examples of shell inlay used in furniture, gaming boards etc. (Mackay,1929; 1938; etc.) Shell inlay was also used to accentuate features or decorations on statuary (Marshall, 1931:566, Pl.XCVIII). On most inlay pieces, the edges have been intentionally bevelled to facilitate setting, which was evidently done using a form of gypsum plaster (Marshall,1931:Vol.I:566). Some pieces also have traces of red , and occasionally black

pigment around the edges or inside the incised designs. Unfortunately, no examples of inlaid wooden objects have been recovered from Mohenjo Daro, but ceramic motifs can provide us with some idea of the exquisite geometric and floral designs made from the white shell, outlined in red and black.

SPECIAL OBJECTS

This group includes all of those shell objects not covered by the above categories, and only a few of the major types are discussed below, because it is not in the scope of this thesis to present a detailed discussion of all the different varieties. The craftsmen at Mohenjo Daro were extremely skilled at working shell and they used specific portions of the different species to produce a wide range of objects that were often made in terra cotta as well as other materials.

TABLE 3-10: MOHENJO DARO; SPECIAL OBJECTS.

ARTIFACT TYPE	SPECIES	PORTION
Cone	*T. pyrum*	columella
Cylinder	*T. pyrum*	columella
Gaming Piece	*T. pyrum*	columella
Sphere	*T. pyrum*	columella
"Wavey Ring"	*T. pyrum*	columella

"Cap"	*T. pyrum*	body whorl
	F. trapezium	and
	C. ramosus	spire
Toy Cart Frame	*L. truncata sebae*	outer lip
Animal Figurines,	*L. truncata sebae*	outer lip
Bull, Tortoise,	*L. truncata sebae*	outer lip
Gharial, Bird	*L. truncata sebae*	outer lip
Snake, Frog		
"Libation" Vessel	*T. pyrum*	entire shell

Most objects in this group are solid, heavy pieces made from the thickest portions of various shells. The massive columella of *T. pyrum* was used to produce a wide range of these objects (Fig.12-1;2). Numerous pointed cones have been found that are similar to the more common terra cotta cones (Marshall,1931:476), but unfortunately the examples in shell do not shed any more light on possible uses for this simple object. The columella was also used to make various sizes of solid and perforated cylinders. Many of the solid cylinders appear to be rough-outs for making smaller objects, such as spheres, "gaming pieces" or "wavey rings" (Fig.3-12;3 to 6,7 to 10). Some of the large perforated cylinders are smoothed from wear on the exterior as well as the interior of the hole, suggesting their use as an ornament. Other examples , however, are only smoothed on the exterior, but not inside the hole. These may have been used as components in segmented or composite rods as has

also been suggested for the "wavey rings" by Mackay (Marshall; 1931:475). After considerable detailed examination of these artifacts, I would agree with Mackay's interpretation, primarily on the basis of the lack of wear on the interior and the ends of the "wavey rings" and the presence of a high polish on the exterior. The only major problem is that we have found no evidence of a paste of mastic used to join the rings on a central rod, but this discussion must await further research and exploration.

Another intriguing object is the shell "cap". These objects were comprised of two or three convex pieces that theoretically joined together to form a low, flat-topped dome. The exteriors are incised with single or parallel groves (Fig.3-12;16) that were often filled with red coloring. So far, however, no matched sets have been recovered and their function is still a mystery. They were made from three different species, T. pyrum, F. trapezium and C. ramosus.

Although the columella of the T. pyrum is massive, it is not quite as large as the outer lip of Lambis truncata sebae, and most figurines ond toys were made from this shell. Generally, the thick digitations on the edge of the outer lip were sawn off to make the head of bull figurines. These figurines were made in two parts, the head and the hump (Fig.3-14;1,2), but up till now no other body parts have been discovered. It is possible that these fragments were joined onto the composite rods as a carved standard or

possibly set into the pommel of a tool/weapon. Other types of figurines include tortoises ? (Fig.3-12;14), gharials, birds (Fig.3-14;3), snakes ? (Fig.3-14;4) and frogs (Fig.3-14;5). The carving on all of these objects is so exceptional that one can only assume that Mackay was speaking in a different context when he suggests that the shell workers of Mohenjo Daro were not so "adept" as the Sumerians (Marshall,1931:568).

One other group of special objects deserves special mention, particularly because its significance has been overlooked in the earlier reports. These are called "shell receptacles" by Mackay and he mentions that "In Sumer similarly smoothed shells were used as drinking cups or for libations or ablutions (Marshall;1931:569). These objects are almost exclusively made from Turbinella pyrum (only one possible example is from C. ramosus) and are basically just a hollowed out shell. The apex was left intact, and the columella and internal septa were tediously chiseled out. This difficult process was often even further extended by the careful smoothing of the interior chipped edges, while the exteriors are always smoothed and incised with single or parallel grooves. These grooves were then filled with red coloring. I have called these "libation vessels" because of their special manufacture and shape , which is suited to pouring some form of liquid. There are no evidences of burning at the edges, so we can rule out the possiblity of their use as lamps. In South India similar, unincised, but

hollowed out shells are used by traditional mothers, to milk-feed infants (Chapter IV). More elaborate and carefully manufactured vessels are made in the shell manufacturing centers in Bengal for special ritual libations, but some of the simpler styles are identical to those found at Mohenjo Daro (Fig.3-15;4 to 6).

DISTRIBUTION OF SHELL ARTIFACTS

Early excavations: Marshall & Mackay.

Our present understanding of the shell industry at Mohenjo Daro is based primarily on the data presented by Marshall and Mackay in the original excavation reports (1931 and 1938). Mackay's technological interests led him to study many of the craft activities represented at Mohenjo Daro, but shell working was evidently not one of his main interests. In the first report, only ten different species of mollusca were identified (Marshall,1931:664-666), whereas now, over 33 species have been recorded from the site (Appendix III:4). The technological aspects of the shell industry were also dealt with quite briefly; a short reference was made regarding the possible similarity of the bangle manufacturing industry to the modern industry in Bengal, and a general discussion was provided on the possible different manufacturing techniques used to cut and shape inlay pieces (1931:563-570). Mackay notes that " in the manufacture of shell inlay, however, the people of

Mohenjo Daro were not so adept as the Sumerians. In India, we do not find the wonderful figurines carved in this material that we find in Sumer. Possibly the people of Mohenjo Daro used wood as their chief medium of expression "(1931:568). He also points out that the major species used at the site was <u>Fasciolaria</u> <u>trapezium</u>. A reexamination of the shell artifacts indicates that although <u>F</u>. <u>Trapezium</u> was indeed important in the manufacture of inlay, it was by no means the major species used at the site, this position is held by <u>Turbinella</u> <u>pyrum</u>. Fortunately, the generalizations and interpretations made by the earlier excavators were based on excavated shell artifacts that were recorded by provenience and preserved for future study. It has been possible to relocate most of the shell objects recorded in the field registers, but the descriptions are often brief and occasionally incorrect, indicating that the recording was done without making a detailed examination of each object. This lack of interest can be understood in view of the large quantities of artifacts that were being processed, but cannot be ignored when assessing the reliability of the artifact descriptions in the registers.

Another problem in understanding the shell industry at the site, is the relative chronological position assigned to different architectural levels. Both Marshall and Mackay were aware of the stratigraphic complexity of the site, but they were not able to resolve the problem satisfactorily. Consequently, I have hesitated to use their designations of

Late, Intermediate and Early when discussing the different shell working areas or proveniences. This problem of stratigraphy also effects the interpretation of the horizontal and vertical distribution of the artifacts. Generally speaking, the excavation reports do not go into detail describing the contexts in which shell artifacts were found. Without this information, it is difficult to understand the processes involved in the final deposition of the artifacts and any conclusions based on the published reports, must necessarily remain generalized and conjectural.

Nonetheless, certain areas of the site appear to have been used specifically for the manufacture of shell objects, and these can be recognised by the presence of raw materials, unfinished pieces, manufacturing waste, finished objects and occasionally even tools (Fig.3-16).

In "L" area, south of the stupa mound, a large quantity of unworked and partially worked F. trapezium was discovered in the partitioned apartments south of the "Pillared Hall". Marshall suggests that shell workers came and occupied these quarters after the original function of the building had ceased, and assigns this occupation to the "latter end of the Late Period" (1931:165). He mentions that in some areas the "late " floor was still used by the artisans , while in other areas they had built up mud floorings. In one of the adjacent chambers (Chamber 6) a large sandstone grinding stone was found , which Marshall

interpreted as being a possible leather-worker's whetstone. On the basis of its association with shell fragments and inlay manufacturing waste, it is more likely to have been used as a grinding stone or whetstone by the shell workers. One further point of interest that has come out in the restudy of the shell fragments from this area, is that there is a conspicuous lack of shell bangles and bangle manufacturing waste. From the entire "L" area excavations, only three shell bangle fragments are recorded in the registers, and there are very few examples of T. pyrum wasters. Most shell fragments belong to F. trapezium, with a few examples of Lambis sp. and C. ramosus. Almost all of the shell wasters from this area are definitely related to inlay manufacture, or the manufacture of discs and beads.

Another possible workshop for inlay is in the "HR" area (Section B, Block 2, House IX, Room 85), where quantities of inlay and waste pieces were found, together with a copper chisel (Marshall,1931:195). The room in which these artifacts were found, was supposedly built in the "Intermediate" period and then rebuilt again in the "Late" period. Not far from this building, another area was located that may have been used for processing "oyster" shells to make lime/gypsum plaster (Block 2,House X, Rms.134,135)(Marshall 1931:197).

The presence of a wide range of waste fragments from different stages in bangle manufacture, indicates that bangle manufacturing was definitely being carried out

somewhere in or near the site. One possible manufacturing area was located in "VS" area (Block 2, House XIII), where numerous broken shell fragments and 41 shell cores were found. After examining many of these cores or rather columellae, it was evident that they were all from Turbinella pyrum, and sawn from the shell in the process of bangle manufacture. This collection of columellae could indicate a primary context where the shells were actually sawn, or it could represent a storage area or workshop where they were being reprocessed to make cylinders, cones , beads, etc. If we had the more details regarding the stratigraphy of this area it might have been possible to interpret this cache more specifically. In "HR" area (Sec. A,Blk. 2,east of house III) we encounter a similar situation, where a large pot was found containing 15 complete, but unfinished shell bangles. From ethnographic examples in the shell working community in Bengal, we know that merchants often provide workmen with unfinished bangles , to be processed at home and then returned after they have been ground and carved. The cache of unfinished bangles could have been passing through a similar chain, when it was lost or abandoned.

Burials are another important context where shell artifacts have been recorded. Though no major cemetery has been found at Mohenjo Daro, some so called "fractional burials" are reported from different habitational areas of the site. In one of these, a skull was found "in a

potsherd" and a shell "spoon" was recorded among the other cultural debris in the same strata (Marshall, 1931, Vol.1:82,Pl.XLII,d). Another reported association is of shell bangle fragments with a skull and finger joint that were found in a subterranean chamber (Ch. 3, Bldg.XXI,Blk.4, VS Area,Ibid.:87). This feature has been classified as a "Post Cremation Burial" on the basis of ashes and charcoal occuring with the bones and other objects (T/C figurine fragments, chert scraper, etc.). Only one other occurance is reported, but this is again in a questionable context and does not indicate any intentional association. In one room (House X,Rm.174,Hr Area, Ibid.:184,Pl.XLVI) a large number of skeletons were discovered lying on top of each other as if they had all been dumped there, and on the left wrist of one of these unfortunate individuals (sex not determined) a complete shell bangle was discovered. None of the other individuals had any shell ornaments, but some had copper rings as well as bangles.

The presence of shell with burials was a common practice during the Neolithic and even the later periods at Mehrgarh, but it does not occur with the same frequency or quantity during the Indus Period. More evidence is seen in the burials at Harappa, Kalibangan and Lothal, and this topic will be discussed in more detail below.

These few examples are the only clues provided in the excavation reports regarding the role of shell working at

Mohenjo Daro. The only way to acquire new data would be to prepare a map of the overall distribution of the different artifact types on the basis of my reanalysis of the shell artifacts collected by the early excavators. Presently, specific programs are being developed to relocate the artifacts in the proveniences that are recorded in the original field registers. This study is being done in cooperation with the more comprehensive program being undertaken by Dr. Michael Jansen and his team on the relocation of all artifacts recorded in the registers. By relocation, we are referring to the three dimensional relationship of specific objects to the architectural features with which they are associated. The results of this study will be presented in more detail when the analysis of the registers has been completed.

Surface Survey, 1982-83

One important objective of the surface survey carried out by the German and Italian Project at Mohenjo Daro was to sample the unexcavated surfaces of the site to try and locate possible shell manufacturing areas. Another objective was to examine the previously excavated sections and dump areas in order to better understand the contexts from which shell artifacts were recovered and also to determine what types of artifacts were discarded in the dumps.

Over 700 shell artifacts were recovered from the exposed surface areas of the site, coming from three

basically different contexts, 1) in association with excavated structures, 2) in dump areas , and 3) on unexcavated eroded surfaces.

Only a few artifacts were recovered from the previously excavated areas and these are comprised of fragments of finished ornaments, utensils, etc. The dumps however, yielded a large quantity of wasters as well as semi-finished objects. In the L Area dump (Fig.3-16) there were 53 wasters of F. trapezium, variously sawn or chipped and all resulting from inlay manufacture. Only one fragments of T. pyrum waste was found in this same area, and this appears to have been a waster from inlay manufacture and rather than from bangle maufacture. Only four finished bangle fragments were recovered from the dump, bringing the number of shell bangles from L Area to a total of seven. The evidence of inlay wasters from the dump areas would lend support to the interpretation that this was an inlay manufacturing area, but unfortunately it does not throw any more light on the problems of chronology or rare occurance of shell bangles. Similar concentrations of F. trapezium fragments were found in the dumps associated with SD Area and the excavation of the so called "Granary". Other dumps from VS Area, HR Area and DK Area were also examined but they do not provide any conclusive evidence for specific types of manufacturing activities, because of the small sample size and the varieties of artifact types.

In the unexcavated areas within the main site we found

only two important concentrations of manufacturing waste, one in a recently exposed room eroding out of the ridge to the north of L Area, and the other eroding from the northern face of the southern east-west ridge located to the east of HR Area (Fig.3-16). The concentration in L Area consists of inlay waste fragments (8) and unfinished inlay pieces (2). Due to time constraints, this area was not fully sampled, but will hopefully provide an interesting area for study in the following season. It appears that the shell fragments are part of a deposit enclosed by three walls, and as such may indicate a primary manufacturing area where inlay and small ornaments were being processed.

In HR East, the concentration consists of numerous manufacturing wasters from bangle, ladle and also inlay production. The fragments were found eroding from the side of the ridge and lying on the silty aeolian and fluvial deposits at the base of the slope. These fragments could possibly indicate the presence of an ancient dump area, from a nearby workshop, or the secondary deposition of such an area .

The most interesting discovery relating to shell manufacture was on a low mound, several hundred meters northeast of the Moneer Area. Although it has not yet been properly mapped, the eroding structures appear to be oriented in the cardinal directions and the associated pottery and artifacts are all of the mature Harappan period. This mound is isolated from the main site by a recent river

flood channel and is cut in two by an old road leading to Dokri village. The eastern portion of this mound was covered with large quantities of tiny chipped fragments of *T. pyrum*. This type of fragment is produced during the preliminary chipping stages of bangle manufacture, when the apex is perforated and the internal septa are broken. The hollowed out shell would then be sawn into rough circlets. Only a few fragments of these subsequent stages of manufacture were found during the sampling of this area, suggesting that this location may have been used for only the preliminay preparation of the shell for sawing.

In addition to the location of these important manufacturing indicators, other shell artifacts were recovered that were used by bead drillers as backing for a bow drill (Fig.3-13;3). These pieces were made from broken fragments of ladles or sawn wasters that fit easily in the palm of the hand. By placing the concave side against the back of the drill , steady pressure could be applied during the drilling process. Numerous shallow depressions in the concave portion of these pieces indicate that the back of the drill shaft was probably tipped by a stone or copper/bronze point. It is possible that the shell pieces were being used by craftsmen who were drilling shell beads but they may also have been used in drilling other types of beads or ornaments. Further surface analysis in the areas where these objects were found may help in our understanding of these other important craft activities at Mohenjo Daro.

Due to the relatively small and diverse samples of shell artifacts found during the 1982-83 surface survey in specific localities, it is difficult to get more than a general impression of the relationship between manufacturing waste and finished objects. Nonetheless, this sample is very useful for comparative purposes and illustrates the important information that can be collected through surface collection. In the following section I have listed the tabulations and frequencies from the surface survey separately in order to show how they relate to the corresponding excavated sample.

TABLE 3-11. GENERAL GROUPING OF SHELL ARTIFACTS

	EXCAVATED		SURFACE SURVEY		TOTAL SAMPLE	
	#	%	#	%	#	%
Finished Objects	1354	63.8	294	43.7	1648	58.95
Unfinished and Waste	729	34.4	369	54.8	1098	39.30
Not Determinable	39	1.8	10	1.5	49	1.75
Total	2122	100.0	673	100.0	2795	100.0

In the excavated sample we see a predominance of finished pieces over manufacturing wasters, suggesting a bias towards the collection of finished artifacts by the early excavators. This bias has been substantiated by the examination of the old dump areas. The sample from the surface survey , on the other hand shows a more balanced distribution between fininshed and waste, but again we must remember that many of the waste pieces in this sample came from the earlier excavations. Looking at the total combined sample we get a more reliable distribution, showing a definite predominance of finished artifacts over manufacturing waste. This pattern probably reflects the fact that much of the manufacturing waste was recycled to make smaller and smaller objects, such as beads and inlay. In Table 3-12 below, we notice another feature that can be attributed to two different factors; breakage amd

production. The high percentage of bangle fragments probably reflects the fact that a single bangle, especially the thin ones, can result in numerous tiny fragments, whereas bead and tiny inlay pieces would tend to be more completely preserved. With this in mind, the high frequency of inlay, suggests that it may have been equally common with ornaments. On the other hand, the fact that a single shell could produce several bangles, beads, inlay and special objects is definitely reflected in their higher frequency, while only one or two ladles could be made from each shell.

TABLE 3-12. FINISHED SHELL OBJECTS

	EXCAVATED		SURFACE SURVEY		TOTAL SAMPLE	
	#	%	#	%	#	%
ORNAMENTS, Bangles	422	31.6	150	51.0	572	35.1
Other Ornaments	144	10.4	33	11.2	177	10.9
UTENSILS, Ladles	177	13.7	44	15.0	221	13.6
INLAY	423	31.7	33	11.2	456	28.0
SPECIAL OBJECTS	168	12.6	34	11.6	202	12.4
Total	1334	100.0	294	100.0	1628	100.0

The most informative quantitative data is seen in the comparisons within each general category. Looking first at bangle manufacture (Table 3-13), we see about 50% waste to 50%finished bangles. This balance is not reflected in the category of Other Objects, where there is only 34% waste to

62% finished objects(Table 3-14). The differences between these two groups can be explained by the fact that much of the bangle manufacturing waste was used to produce other objects. This explanation however, does not apply to the Ladle category (Table 3-15). Here we note a sharp decrease in waste (15%), and the breakage factor for large ladles cannot be the reason for this disproportionate amount of finished artifacts. Two hypotheses can be suggested for this pattern; either we have totally missed the ladle manufacturing areas of the site, or some of the ladles were being manufactured outside of the site, and were brought in as trade items.

TABLE 3-13. BANGLE MANUFACTURE

	EXCAVATED		SURFACE SURVEY		TOTAL SAMPLE	
	#	%	#	%	#	%
FINISHED	422	54.7	150	38.5	572	49.0
UNFINISHED	44	5.7	28	7.0	72	6.2
MAN. WASTE	305	39.6	212	53.0	517	44.4
NOT DETER.	0	.0	5	1.5	0	.0
TOTAL	771	100.0	395	100.0	1166	100.0

TABLE 3-14. OTHER ORNAMENTS, INLAY AND SPECIAL OBJECTS

	EXCAVATED		SURFACE SURVEY		TOTAL SAMPLE	
	#	%	#	%	#	%
FINISHED	755	66.1	100	44.7	855	62.6
UNFINISHED			(16	7.1)		
AND WASTE	348	30.5	103	46.0	467	34.2
NOT DETER.	39	3.4	5	2.2	44	3.2
TOTAL	1142	100.0	224	100.0	1366	100.0

TABLE 3-15. LADLE MANUFACTURE

	EXCAVATED		SURFACE SURVEY		TOTAL SAMPLE	
	#	%	#	%	#	%
FINISHED	177	66.1	44	81.5	221	84.03
UNFINISHED	24	11.5	5	9.25	29	11.02
MAN.WASTE	8	3.8	5	9.25	13	4.95
TOTAL	209	100.0	54	100.0	263	100.0

Summary

On the basis of these preliminary observations it is evident that Mohenjo Daro definitely had workshops that specialized in the production of shell objects such as bangles, beads, inlay, untensils and other decorative objects. The excavated materials and the collections from the surface survey have provided us with a fairly comprehensive set of data representing all of the basic manufacturing stages of the various types of objects, and it is evident that large quantities of bangles, inlay and other special objects were being made at the site. Ladles too, were being made there but it is possible that some finished ladles were being brought to the site from other manufacturing centers. The raw shells , however, were most certainly transported to the site, and three major source areas can be defined on the basis of modern distributions of shell species. The raw shells were probably brought to the site along riverine trade routes or possibly overland, and from Mohenjo Daro, it is likely that many shells were traded further into the interior. In terms of finished shell objects however, the quantity of shell wasters discovered from the site do not indicate a large scale industry manufacturing products for trade purposes. The size of the work areas discovered so far at the site suggest that the industry was guaged for local markets either within the city itself or at the most for nearby communities that had close contacts with the urban center.

For number sequence only.

Harappa

The site of Harappa was excavated by M.S. Vats in the 1920's to 1930's at about the same time that Mohenjo Daro was being excavated. No recent surveys have been made at the site, but it is estimated to have covered the same total area as Mohenjo Daro (85 hectares) (Vats,1940). A high fortified mound dominates the site, which consists of several other lower mounds to the north, east and south, while the river apparently flowed on the west. Numerous similarities in the material culture and the layout of the two cities lead to the assumption that they were contemporaneous and had constant mutual contacts (Vats,1940:2). This assumption has since been questioned, and Fentress (1976) has recently shown that there were numerous differences; in their ecological setting, their access to raw materials, the varieties of artifacts represented and possible functional aspects of structural complexes, particularly the citadel mound and the lower city (Fentress,1976:265-305). Furthermore, she finds that although the sites may have been contemporaneous during the Mature Indus period, there is a considerable time lag between the earliest occupations at each site, and also the latest occupations(Ibid.,288). Most of these comparisons are necessarily based on the meagre evidence provided by the excavation reports and the original field registers from Mohenjo Daro, which in themselves have been shown to be somewhat unreliable (Appendix III:8). Nonetheless, her

interpretations may stand up to the tests which she has proposed, and one important interpretation that is being supported by subsequent analysis of the material culture is the role of Harappa as an important center for channeling the resources of the Upper Sindhu/Nara region to the more heavily populated Lower plain (Fentress,1976:288) This interpretation has been further elaborated by Ratnagar (1982), where she refers to the site as a "gateway" city that was loacted at the base of a dendritic network connecting with resource areas to the north.

The site is situated on the Ravi River, a major tributary of the Sindhu Nadi system, and had more or less direct contact with Mohenjo Daro, some 460 kilometers to the south. Coastal resource areas were much further away, but the site was equidistant from both the western and eastern coasts, from 825 to 875 km. Any goods or raw materials coming from these coasts would have been brought through the networks connected with Mohenmjo Daro and other major urban centers in the Lower plain (Ganweriwala, etc.). This distance from the source and the stages of transport should be reflected in the lower frequency of shell artifacts and fewer varieties of shell species represented, as compared to Mohenjo Daro. In comparing these two sites we must also remember that about twice as much area has been excavated at Mohenjo Daro (Fentress,1976:281), and therefore all frequencies should take this factor into account.

The sample of artifacts that I have been able to record

is considerably smaller than that from Mohenjo Daro (324), but unfortunately this cannot be attributed to the differences in excavated area. Most of the artifacts I was able to record come from the Reserve Collection at Harappa Museum, but as with the Mohenjo Daro artifacts many pieces have been distributed throughout various museums in India and Pakistan. Since I have not been able to locate the original field registers, I do not know what percentage of the excavated collections my sample represents. Most of the fragments are of finished artifacts, with very little manufacturing waste represented (Appendix III:10b). Because of this apparent bias in the collections, I spent three days examining the dumps and eroded surfaces of the site to determine if the manufacturing waste had been simply not been collected, as was often the case at Mohenjo Daro. In the course of this informal surface survey, I found that there were almost no shell artifacts in the old dumps or even on the surface of the site, suggesting that most of the shell had been collected during the excavations.

The most crucial problem in studying the artifacts from the site has been in determining their provenience. Most of the artifacts in the museums have their original numbers removed and there is no way to correlate them with shell artifacts described in the excavation report. This fact is disconcerting when one remembers that there were Buddhist structures on part of the Citadel mound, and a Late Indus occupation after the decline of the Mature Indus phase. At

this point there is little to be done to remedy this problem but questionable artifacts will be pointed out in the following discussion of the shell industry. All artifacts have therefore been grouped together for tabulation (Appendix III:10a).

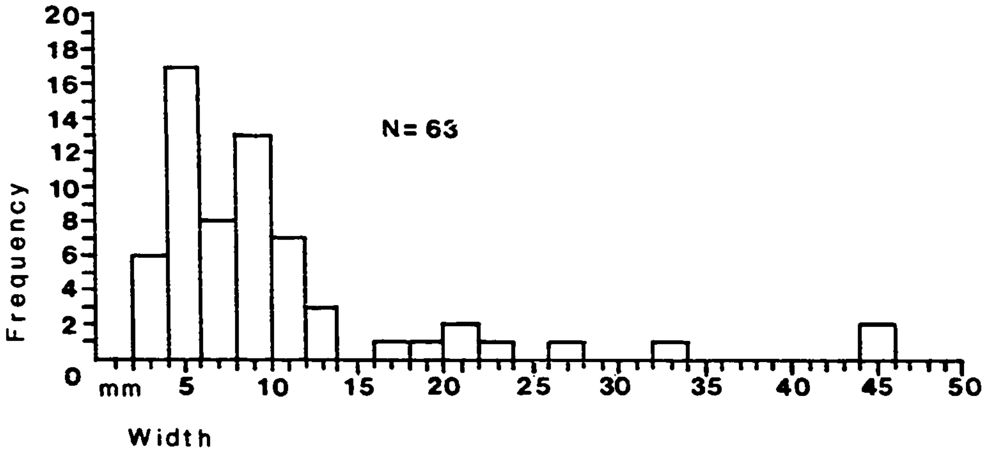
The Shell Industry

As with many of the other artifacts from the site, shell artifacts also have parallels at Mohenjo Daro, but the variety of artifacts and range of species represented at Harappa is considerably smaller (Table 3-17,3-18). Only eight marine species are represented in my sample (Appendix III:10a) and this low number can be attributed to the absence of smaller gastropods and bivalves that were not used in the manufacture of shell artifacts. At Mohenjo Daro these species are generally unworked, and probably represent curiosities rather than commodities. All but one of the major species used in the shell industry are represented at Harappa, indicating a well established network of trade that supplied the workshops with sufficient quantities of raw materials. The range of ornaments produced includes the omnipresent shell bangles, beads and pendants made from waste pieces (Fig.3-20;8), but so far no small rings have been recorded. Vats reports the discovery of 155 shell beads found together in one lot (Vats,1940:433, Pl. CXXXVII,25). They include cylinder discs, short cylinders and short barrel beads. I have not included these in my tabulation because I'm not sure if the identification ofal

of these as shell is valid. Many similar types of beads were made in white paste or stone, and a similar necklace that I examined at the Harappa Museum, turned out to be made up almost entirely of stone beads.

On the basis of the types of manufacturing waste found at the site we can assume that most of these ornaments were being produced at the site itself. The techniques used for producing these objects basically identical to that used at Mohenjo Daro, including the use of a specialized copper/bronze saw. A comparison of the sawn wasters from Harappa indicates that the saw used here was slightly thicker, .6 to .7 mm ,but this variation could be a product of the small sample size and is not significantly different (Appendix III:12). In comparing the widths of bangles being made/used at Harappa, we see a similar rough bimodal distribution between thin (4 to 14 mm) and wide bangles (18 to 24 mm), with some reaching as much as 46 mm.

TABLE 3-16. HARAPPA; SHELL BANGLE WIDTHS.



Most of the bangles were made from Turbinella pyrum but some were being produced from Chicoreus ramosus (Fig.3-17;6,7). Two complete bangles in the Prince of Wales Museum, Bombay provide a striking contrast to the heavier bangles made from T. pyrum (Fig. 3-17;6,7). Both types of bangles are incised with the traditional chevron design over the shell suture, although on some of the C. ramosus bangle (Fig. 3-17;6) it is incised in the opposite direction from the T.pyrum bangles. Several examples of complete wide bangles have also been recovered from the site, showing that they were very massive and yet were incised just like the thinner variety (Fig.3-18;1,2,3). Only a few grooved bangles have been recorded in my sample from the Harappa Museum collection (Fig.3-18;4,5,6), but the origin of these examples may be from the Buddhist period occupation, as was seen at Mohenjo Daro.

Although there are definite stylistic and technological similarities in the manufacture of bangles between the two sites, there is an important difference in the percentage of finished bangle fragments (60%) and manufacturing waste (40%),(Table 3-19). This difference could be a result of poor sampling, but it more likely represents the intensive utilization of the shell wasters. A similar pattern can be seen in the reuse of shell manufacturing waste in rural workshops in Bengal (see Chapter IV).

TABLE 3-17. GENERAL GROUPING OF SHELL ARTIFACTS

	TOTAL SAMPLE.	
	#	%
Finished Objects	208	64.2
Unfinished and Waste	84	25.9
Not Determinable	32	9.9

TABLE 3-18. FINISHED SHELL OBJECTS.

	TOTAL SAMPLE	
	#	%
ORNAMENTS, Bangles	57	27.4
Other Ornaments	21	10.1
UTENSILS, Ladles	14	6.7
INLAY	75	36.1
SPECIAL OBJECTS	41	19.7

TABLE 3-19. BANGLE MANUFACTURE.

	TOTAL SAMPLE	
	#	%
FINISHED	57	60.0
UNFINISHED	6	6.3
MAN. WASTE	32	33.7
TOTAL	95	100.0

TABLE 3-20. OTHER ORNAMENTS, INLAY AND SPECIAL OBJECTS.

	TOTAL SAMPLE	
	#	%
FINISHED	116	74.4
UNFINISHED AND WASTE	40	25.6
TOTAL	156	100.0

TABLE 3-21. LADLE MANUFACTURE.

	TOTAL SAMPLE	
	#	%
FINISHED	14	70.0
UNFINISHED	6	30.0
MAN.WASTE	0	.0
TOTAL	20	100.0

Inlay pieces are quite common at Harappa and many of the designs are identical to those found at Mohenjo Daro. Some of these were being produced at the site and sawn waster from all four of the major gastropods have been found (Fig.3-18;7; 3-19;1,2,3). To avoid needless repetition I have only illustrated a few of the designs that were not illustrated in the previous figures (Fig.3-20;6). Bangle fragments were also reused to make what appear to be inlay components (Fig.3-20;11,12).

Different types of special objects were made from all of the major gastropods and they include most of the common

types found at Mohenjo Daro, as well as certain unexplainable objects. One example of what might be a lid or some kind of stopper is seen in Fig. 3-20;7. They were also manufacturing finely shaped figurines (Fig.3-20;9,10), but no examples of the enigmatic "libation vessel" have been discovered yet. Harappa has a few of its own unique shell artifacts, one being a huge pendant or possibly a gauntlet made from the body whorl of a large _T. pyrum_ (Fig.3-19;4). Numerous holes along both edges suggest that it might have been attached to a heavy multi-strand necklace or torgue, but then again they may have been used to secure the ornament on the wrist. Similar pieces made from the same species are still worn by men and women among the various Naga tribes in North eastern India, while similarly shaped bangles are worn by village women in Bhutan, Ladakh and eastern Tibet.

Another unique artifact is a trumpet, also made from _Turbinella pyrum_ (Fig.3-20;13). This object was not reported in the original report, but on the basis of its registration number it was definitely found in the course of the excavations at the site (R 2332, Lahore Museum # P 501). Made from a medium sized shell, the apex has been perforated to the first whorl using a narrow pointed tool, possibly a copper/bronze chisel, and the "mouth-piece" has been ground to remove the irregular chipped portion. Only the very thin margin of the outer lip has been chipped, indicating that this shell was not intended for the production of bangles.

Furthermore, the inner lip area of the shell and the entire exterior surface is extremely worn from continued handling, and the mouth-piece is also well worn. There is little doubt that this object was used as a trumpet, the question is, was it found in good Indus period contexts or was it associated with the later Buddhist occupation of the site. The letter "R" on the registration number suggests that it might have come from the squares numbered with "R", located to the south of AB Mound. Unfortunately, these squares include habitation and cemetery deposits from both the Mature and the Late Indus phase. Little or no shell is reported at other Late Indus sites in the northern Sindhu/Nara plain and until further information can be gathered about the provenience of this potentially important artifact, I will treat it as a Mature Indus period artifact, but only skeptically. As was seen in the sample of artifacts from bangle manufacturing, there is a higher percentage of finished objects (74%) to waste (26%) in this category as well (Table 3-20).

Looking now at the distinctive ladles made from Chicoreus ramosus we see a difference in frequency from the Mohenjo Daro sample, with only 70% finished objects and 30% waste. It is difficult to understand the reasons for this decrease in finished pieces, especially since the source for this shell is equidistant to that of the other species. The most obvious explanation would be that the small sample size (n=20) is misrepresentative. Nonetheless, the

interpretation would be the same as discussed for Mohenjo Daro, where we assume that some finished ladles were being brought to the site from other manufacturing areas.

Even with these minor variations and the small sample size, the overall frequencies of different artifacts at Harappa are comparable to that seen at Mohenjo Daro (Table 3-17). This similarity should be expected since both sites were large urban centers where a wide range of small industries were represented. A detailed study of the excavation report shows that shell artifacts were found in similar contexts as those from Mohenjo Daro. Many of the artifacts are scattered throughout the habitation areas of the site, but there are some concentrations in Trenches IV and V, north of the Citadel mound, near the so-called "workmen's quarters". In Trench V, stratum II, a large cache of shell wasters and about 4 pounds of finished inlay pieces were discovered (Vats,1940:71-73). Another important concentration was found in strata V and IV (western half of section I) at the southern end of the Citadel mound (Vats,1940:175). In this level, over 41 bangle fragments are reported along with 2 pieces of sheil inlay, 112 miscellaneous beads, faience sealings and 20 chert scrapers (Ibid.). Both of these concentrations are in levels associated with the Mature Indus occupation, and suggest that certain areas of the site were used as workshops for the production of shell objects primarily for local consumption.

Although I was not able to locate any of the shell objects from Wheeler's excavations of the fortification and the cemeteries, he does mention that he found numerous shell artifacts in the "make up of the rampart" (Wheeler, 1947:123,125). These included bangles,"rings" and sawn manufacturing waste. What exactly is meant by "make up" of the rampart is uncertain as there are numerous debris levels on the exterior and interior face of the "rampart". He does not report any shell from the levels beneath the rampart, and we can assume that all of the shell artifacts belong to the Mature Indus phase and not the Early Indus occupation of the site. All of the illustrated examples appear to be made from T. pyrum (Ibid.:Pl.LIV,A;4,5,7,10,12). Wheeler also found shell in other contexts, i.e. with the working platform and in the cemetery area, but since he only illustrates a few examples it is difficult to know what they represent, in terms of style and quantity.

The most important context for shell at Harappa is in the burials of the Mature Indus period, in Cemetery R-37. This cemetery was first excavated in 1937-41 by K.N.Shastri and about 50 burials were uncovered (Wheeler,1947:86). Most of these were extended burials associated with pottery, some copper and shell ornaments and even one example of a shell spoon (Ibid.). No final report has ever been published on the vast amount of artifactual material recovered, but Wheeler notes that " shell bangles and beads of steatite and paste appear to have been the most common accompaniments"

(*Ibid*.). This statement, however, is not supported by what he reports from his own excavations in 1946. Out of 10 burials, 4 of which were completely excavated, only one had any shell ornaments, and they were perforated shell discs, not bangles. This was a "coffin" burial, of "probably" an adult female, and one shell "ring" was found left of the skull and two shell "rings" left of the shoulder (*Ibid*.:87-88). Other grave goods with this burial included 37 pots and a copper ring on the right middle finger. In trying to understand what he means by shell "ring", I can only refer to the illustration of another object which he describes with the same term (Pl.LIV,3), and coincidentally was found on the surface in the cemetery area, In order to avoid confusion with the term that I use to refer to a finger ring, I would suggest that this type of artifact be described as a perforated disc (Appendix II:3). Similar perforated discs are common from the habitation deposits at both Harappa and Mohenjo Daro, and their location around the head of the skeleton suggests that they were used as hair ornaments or pendants.

The paucity of shell artifacts recovered from Wheeler's excavatioms in Cemetery R-37 does not suggest that shell was used as a special grave offering. This same pattern is seen in the description of the grave goods supposedly associated with what he calls "Post Cremation Urns" (Vats,1940:174-175). Only a few fragments of shell bangles and "losenges" were found in these urns, and there is no

indication that they were placed in them intentionally. Most of these urns are found broken, and he does not bother to note whether or not the rims and upper portions of the vessels were found in situ with the lower part of the pot. This information is crucial in determining it these vessels were in fact ritually buried, or simply used as sump pots or trash bins. Even though there is no evidence of a constructed drain leading to these pots, we cannot just assume that they represented burials. The most questionable group of such urns was discovered along the side of a long structure on the southern part of the main mound. Here, there were 54 pots, some stacked 2 or 3 high and all lined up along the base of the structure. None of these contained any human bones, and only six had shell artifacts in them (Vats,1940:Table II,pp.272-274). Other artifacts found in these urns included the bones of small birds or fish, T/C bangles and figurine fragments, decayed grain and charcoal (Ibid.). The assorted contents could basically be described as debris, particulary the types of debris that would accumlate in ditches or low areas of the site. Furthermore, the placing of one pot inside the base of one or more previous vessels and the fact that all but two of them were broken suggests that they were not realy meant as offerings, but rather trash bins. Why so many of them were aligned together could undoubtedly be explained if we knew more about the related architecture. Not far above these vessels is the spot where the group of 41 bangles were found.

In contrast to the reported quantity of shells in the Mature Indus burials and so called "post cremation urns", Vats does not report any shell from the Late Harappan pot burials or the extended burials in Cemetery H (Ibid.:175). Only one wide shell bangle was found in this area and it was not associated with the burials, but rather with the debris in Stratum II (Ibid.:449).

The object of all this detailed discussion is to clarify the misconception that was reinforced by Wheeler, regarding the common occurance of shell bangles in Harappan burials. Furthermore, the few occurances of shell in the so called burial urns should be attributed to debris accumulations and not related to burial practices.

Getting back to the discussion of the shell industry, we can assume that shell raw materials and some finished objects were being brought to the site along the major communication route extending south to the Lower Sindhu/Nara plain. The distance from the coast and the presence of intermediate stations, i.e. Mohenjo Daro or Ganweriwala, is reflected in the decrease in the number of species represented and the intensive reutilization of waste materials. It appears that the production of artifacts was not on as large a scale as we saw at Mohenjo Daro, and was probably directed towards local comsumption rather than for trade to the peripheral regions. The presence of shell wasters in the "make up" of the rampart suggests that the industry was fairly well established by the time the rampart

was built, but there is no evidence for its presence during the Early Indus occupation of the site.

Balakot

Having examined the two most important inland urban centers, we now turn to Balakot, a small town located on the Western coast, near the major source for Turbinella pyrum and many of the other smaller species. The setting of the site has been discussed above and we know that prior to the Indus occupation, there was a limited amount of shell being used and worked at the site. After a hiatus, possibly as long as 500 years (Dales,1979:247), the site was reoccupied. This new settlement was built up by people of the Mature Indus culture and unlike the earlier inhabitants, their subsistence and economy included the intensive exploitation of marine resources, in addition to farming and animal husbandry. We do not know if this change in subsistence strategies was abrubt or a gradual process, because the earliest Indus occupation levels have not been properly sampled by horizontal excavation. However, in the middle and upper Indus period habitation deposits there are large quantities of fish bones and molluscs. Some of the molluscs were collected only for consumption, but the shells of the larger species were used for making various ornament (Dales and Kenoyer,1977). The final analysis of the stratigraphic relationships of the shell artifacts has not yet been worked

out, so we cannot discuss internal developments during the Indus occupation, but I have been able to record and study almost all of the shell from all four seasons of excavation. In my recording I have not included the tabulation of the Terebralia palustris fragments because these shells were being crushed to obtain the meat. These fragments are being included in a separate study of subsistence patterns at the site, by Richard Meadow (Meadow,1979). Some of the other shell artifacts that I have not recorded have already been reported by Durante (1977,1979) and some minor revisions will need to be made in the tabulations presented below when this remaining sample is included. Furthermore, there are some discrepancies between my information and Durante's in terms of nomenclature and the reported distributions of certain species Some of these are discrepancies are insignificant archaeologically, for example Polynices mamilla is more properly referred to as Polinices tumidus (Smythe,1982), but others are extremely important, especially the identification of Turbinella pyrum and other species on the basis of non-diagnostic fragments.

TABLE 3-22. BALAKOT; FINISHED SHELL OBJECTS, PERIOD II.

	#	%
ORNAMENTS, Bangles	664	95.0
Other ornaments	25	3.6
UTENSILS, Ladles	2	.3
INLAY	0	.0
SPECIAL OBJECTS	8	1.1
TOTAL	699	100.0

The Shell Industry

Balakot provides an entirely different perspective of shell working from what was seen at the inland urban centers. Being near the coast, it is not surprising to find a much greater variety of species (46, Appendix III:14 ; Table 3-22). This diversity is due to the presence of the smaller shell species, many of which have not been worked in any manner. In contrast, we see a very limited variety of worked shell and a low frequency of artifacts other than bangles (Table 3-22). No inlay pieces or tubular drilled fragments have been recovered, but the discovery of one chipped spire of *Fasciolaria trapezium* may indicate that they were making some inlay that we have not yet discovered.

Only a few types of artifacts are seen in the other categories, including thirteen shell beads, ten of which are made from the naturally perforated *Dentalium*. Several examples of perforated natural shells have been found, but no intentionally shaped pendants. Among the special objects, we have only two different types, one example of an

incised "cap" (1/3 circle variety) and seven perforated *Anadara* sp. The perforations are made on the umbo simply by grinding, and since none of these show any wear from having been strung on a cord, it is suggested that they were containers used to dispense some type of liquid or medicine. No ladle manufacturing waste has been discovered yet, but there is one example of an unfinished ladle fragment. Perhaps the sawn ladle roughouts were being brought to the site by itinerent specialist/traders who completed their work according to demand. *Chicoreus ramosus* is not common on this coast, and the presence of two finished ladle fragments obviously represents some contact with either the inland sites where we know that they were made, or the trade/exchange networks connected to their source in the Gulf of Kutch. The other source for this shell is off the coast of Oman, but no evidence of ladle manufacture has been found there yet.

Bangle fragments and manufacturing waste make up the largest proportion of shell artifacts, and these were being produced by two radically different techniques. In one process, the large gastropod *T. pyrum* was being cut with a copper/bronze saw, while in the other, the large bivalve *Tivela damaoides* was being chipped and ground. At first glance the resulting bangles are quite similar, but on closer examination there are numerous differences that result from the different techniques and raw materials being used. These differences require that each sample be

recorded and discussed separately.

TABLE 3-23: BALAKOT, BANGLE MANUFACTURE.

	Gastropod		Bivalve	
	#	%	#	%
Finished	201	65.7	463	29.0
Unfinished	30	9.8	232	14.5
Man. Waste	75	24.5	903	56.5
Total	306	100.0	1598	100.0

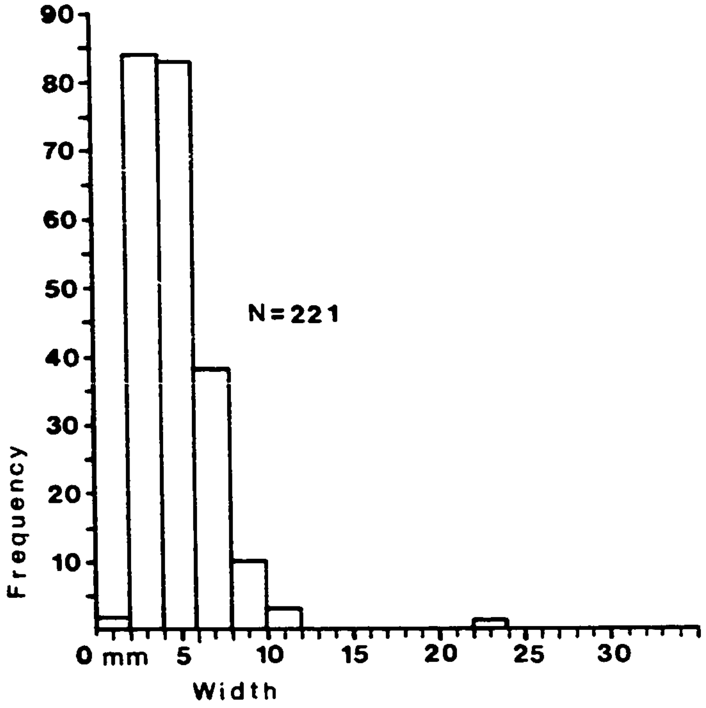
In the sample of bangles made from gastropods, we find that some were made from Chicoreus ramosus and others from T. pyrum. No bangle manufacturing wasters of the former species have been found, so we can assume that these bangles were brought from outside the site and only T. pyrum was being processed here. The overall frequency of finished bangles to manufacturing waste is seen in Table 3-23, but by excluding the 23 examples of C. ramosus we have a more accurate representation of the industry, 67% finished and 37% waste fragments. Assuming that this ratio, 1:.58 is representative of a primary manufacturing site, we are faced with unexplained frequencies at Mohenjo Daro (41% to 51%) and Harappa (60% to 40%). The possible implications of these variations will be further discussed when we have looked at the sample from Lothal.

In terms of technology, the saw used at Balakot was identical to the ones used at Mohenjo Daro and Harappa. On

the basis of seven measured saw cuts we can reconstruct the cutting edge as being about .5 mm thick (n=7 mean= .42).

Most of the bangles are of the thin variety (Table 3-24) and all incised examples show the traditional chevron motif incised over the suture (Fig.3-22;1,2). Grooved bangles have also been found at the site (Fig.3-22;9), but they are associated with the later pre-Islamic occupation of the site (Dales,1979:31) and none have been found in sealed Indus Period contexts.

TABLE 3-24: BALAKOT; BANGLE WIDTHS.



The gastropod bangles from Balakot represent the same stylistic and technological tradition found at the other urban sites of the Mature Indus period, but the bangles made from bivalves, definitely represent a regional style. The

shell most commonly used in their production was *T. damaoides* , but occasionally the smaller, skewed *Callista impar* was processed. These bivalves were probably obtained from the sandy beaches on the nearby coast and the process of manufacture involved several alternating stages of chipping and grinding (Dales and Kenoyer,1977). On the basis of a detailed analysis of the manufacturing waste, ten basic stages of production can be distinguished (Table 3-21).

Due to the size and structure of the bivalve, finished bangles vary in width from dorsal margin (4 to 7 mm) to the ventral margin (2 to 3 mm). No wide bangles can be produced from these shells so all *Tivela* bangles would be considered thin. Obviously, in this context, the disticntion is meaningless because it is a function of the raw material and not the direct result of cultural preference.

On almost all examples, incising was done over the thickest part of the hinge where the anterior lateral tooth occurs. Two variations are seen in this incised motif, one is the traditional chevron and the other is a simpler version that is just a diagonal line with a short hook at the end (Fig.3-22;4 to 7). These motifs appear to be direct imitations of the chevron design on the gastropod bangles,

but due to the lack of a guiding suture there was a slight modification in the length of one of the strokes. The incised design was generally made with a chert blade, which leaves slightly irregular striae at the edges of the line (Fig.3-22;6). The striae on the gastropod bangles are usually straighter and quite regular, indicating the use of a metal saw or file. Although, the bivalve manufacturing process did not need any metal tools, two examples of sawn Tivela wasters indicate that some experimentation was done to see if it would be more efficient to cut the bangles with a saw (Fig.3-24;1,2). This innovation apparently did not take hold, possibly because the structure and size of the bivalve was more suitable to chipping and grinding than to sawing. The laminated structure of the shell can be readily identified on finished fragments, and in this way it is possible to differentiate between the two traditions of manufacture.

In order to better understand the various production stages and the time involved in producing the Tivela bangles, a detailed replicative experiment was conducted (Appendix III:16). The results of this experiment show that one bangle could be produced after 1.5 to 2 hours of continuous labour and out of 13 shells, the percentage of complete bangles was only 38% (8). Breakage generally occurred during the chipping or grinding in stage seven, and although a more experienced craftsman could probably reduce both the breakage rate and the time involved, it is unlikely

that more than four to six bangles could be produced in seven hours of continuous labour (see discussion in Chapter IV). A study of the percentages from each stage of manufacture shows that as in the experiment, most of the breakage occured during the chipping stages, either in stage four or seven (Kenoyer, n.p.). In tabulating the broken fragments from the experiment, I used the same criteria as for the excavated sample and the results were, 87.1% waste to 12.9% finished bangles. These frequencies can be compared with the ancient sample (Table 3-23), and it is quite obvious that the ancient craftsmen were much more skilled, nonetheless, 71% waste is much more than what is seen in the production of gastropod bangles (65.7%).

Many questions can be raised as to why these two traditions existed side by side, especially when it appears that it was more efficient to produce bangles from sawing the large gastropods. The most logical explanation would be related to the availability of specialized metal saws. Without doubt, these tools were an expensive commmodity that would not have been available to just any old beach-comber. Craftsmen possessing such specialized tools were probably supported or controlled by more affluent individuals. Nevertheless, the demand for bangles was such that enterprising individuals were producing comparable products using a simpler technology and a readily available raw material. The only investment required was time and lots of patience.

The presence of a market demand for Tivela bangles raises the important question of identifying the market. Were these ornaments being made for local consumption or for trade to the adjacent regions ? No Tivela bangles have been reported from sites in the central Sindhu/Nara region in the central valley, but there are examples at sites along the Western Coast. I have not been able to examine any of these examples first hand, but on the basis of diagnostic structural aspects of the bivalve, such as its triangular form, it is possible to differentiate them from bangles made from T.pyrum. Sutkagen Dor is the westernmost site of the Indus Civilization and collections made by Stein as well as Dales (pers. comm.), indicate that shell bangles were being used at the site. Two of Stein's illustrated examples can be identified as Tivela bangles (Stein,1931:Pl.VI,Su.6 and Su.v.a.1). Other examples of this type of bangle have been noted at Sotka Koh (Dales, pers. comm.) and possibly occur at Shahi Tump (Stein, 1931:32-33, Pl.XIV, Sh.t.i.1). All of these examples appear to be finished pieces, and since no manufacturing waste has been reported, it is possible that these bangles were being distributed to the sites through coastal networks unrelated to the major seaboard trade between the Indus urban centers and Mesopotamia. The only nearby occurance of Tivela bangles is seen at the site of Allahdino, east of Balakot.(see below)

The absence of Lambis truncata sebae and the discovery of only one example of Fasciolaria trapezium at Balakot are

important because it might imply that the site did not form a link in the major trade system connecting the inland urban centers with Oman and the Gulf region.

Allahdino

Allahdino is a small site (1 hectare) located at the western border of the Malir River flood plain, some 25 kilometers east of Karachi (Fairservis,1982:108). The duration of the occupation is estimated between one and three hundred years, all of which transpired during the Mature Indus period (Hoffman and Shaffer,1976?:94-96). Situated on a rich alluvial plain, the settlement represents a small selfsufficient farming community of about 80 individuals (Fairservis,1982:111). Most of the artifacts at the site (95%) could be made from raw materials available within a 50 kilometer radius and Fairservis interprets this to mean that trade was not significant "either in the location of the site or deeply involved in its function." (Ibid.,112). Although the site is not actually on the coast, it access to a wide variety of estuarine and marine resources from both the Sindhu/Nara Delta region (and the Malir River) as well as the Arabian Sea. Over 30 species of marine and freshwater mollusca have been identified at the site and even though marine exploitation was not a primary subsistence strategy it is evident that a limited amount was being carried out (Appendix III:22 ; Turnbull,1982 and personal study). Molluscs were used for food as well as a raw material in the manufacture of ornaments and utensils.

In the course of my study I was able to examine a number of artifacts from the excavation and visit the site, where I found evidence for the limited manufacture of both Turbinella pyrum and Tivela bangles. The techniques used were similar to what has been described above for Balakot. In the field registers I found records of 263 bangle fragments and 7 shell wasters, but these bangle fragments include both finished and unfinished examples (personal study). All of the bangles that I was able to examine were of the thin variety, and a few were incised with the traditional chevron motif. In addition to these ornaments, 11 cylinder disc beads, 3 shell beads and one tubular bead were recorded in the field register. Ladles made from Chicoreus ramosus are also found at the site, but since no manufacturing waste has been discovered, we can assume that they were not being made there. One repaired handle of such a ladle suggests that these objects were of considerable value, which is understandable when the source for this species in the distant Gulf of Kutch. The presence of ladles indicates that Allahdino did have trade contacts with the major network that connected the Gulf of Kutch with the lower Sindhu/Nara plain. All of the other species represented at the site are locally available and the inhabitants could have collected them for food or as curiosities. There is no evidence for large scale manufacture at the site, and it is unlikely that shell working was being carried out by farmers or herdsmen. The

evidence of shell working may therefore represent the presence of itinerant shellworkers/traders who brought their raw materials and wares to the smaller rural sites where they worked for awhile before moving on.

I have not been able to determine what other types of shell artifacts were at the site, and it will be interesting to see if any of the types of inlay or special objects found at Mohenjo Daro are represented. The absence of _Lambis truncata sebae_ and _Fasciolaria trapezium_ would suggest that this site did not have access to the same commodities that were going to the larger urban centers, though it was situated near the major route from the coast up the Sindhu/Nara plain.

Lothal

The site of Lothal is situated on the flat alluvial plain between the Sabarmati and Bhogava Rivers. Much of the site is now covered by silt deposits, but the exposed mound forms a rough oval that is approximately 300 by 250 meters in area, and about 2 kilometers in circuit (Rao,1979:62). Although the earliest levels of the site have not been excavated there are areas where the Mature Indus occupation is seen resting on sterile soil. The excavator has interpreted this early settlement as being a small village that later developed into a major sea port of the Indus Civilization (Rao,1979:52). This port city was divided into a lower town and a more or less central "acropolis" much like the larger urban centers of Mohenjo Daro and Harappa.

Similarly, the structural units were built along a gridiron pattern oriented in the cardinal directions. A massive retaining wall or embankment of mud-bricks surrounds the site, evidently for protection against flooding, and in the north this embankment was reinforced with baked bricks. On the western periphery of the city a small cemetery has been discovered and on the east is a large tank that is sometimes referred to as a "dock" (Rao,1979:58-62). This tank was filled by overflow from an ancient river or tidal channel that lead to the Gulf of Khambhat. Presently the gulf is some 35 kilometers to the south, but during the 3rd millennium B.C. it probably reached much closer to the site (Ibid.:19).

In the earliest occupation levels (Period A, phase I) shell bangles have been reported along with other diagnostic Mature Harappan artifacts, but the excavator feels that the Mature Indus occupation was not fully established until what he defines as Phase II. This occupation continues through Phase III (2450 to 1900 B.C.) and then in Period B, phases IV and V he sees a slight change in the cultural materials is identified with the decline of the Mature Indus tradition. On the basis of C14 dates and comparisons with other sites in the region he dates the Late Indus occupation from 1900 to about 1600 B.C. (Ibid.:39).

With the kind permission of the Archaeological Survey of India, I was allowed to study almost all of the shell artifacts recovered from the excavations. This large sample

has been well recorded in terms of having numbers and proveniences for most of the artifacts, but it has not been possible to relate these numbers with the complex strtigraphic sections published in the most recent site report (Rao, 1979). For the purposes of this study it has been necessary to combine all of the sample together, a situation that was necessary at both of the major urban centers already discussed. "Lumping" of chronologically varied materials is not the most desirable way to study this complex industry, but since the Late Indus phase at Lothal represents a modification of existing traditions rather than the intrusion of an alien culture, this approach is somewhat justified.

The Shell Industry

Unlike the smaller coastal town of Balakot, the shell workers at Lothal made a wide range of artifacts similar to those seen at Mohenjo Daro and Harappa. All of the major categories are well represented (Appendix III:17) and there are several special objects that are unique to the site itself. Looking first at the ornaments, we see a large quantity of beads, but actually over 200 of these are merely fragments of Dentalium shells. The excavator has described these as tapering shell beads, so I have included them in this category, but they may or may not have been used as ornaments. The remaining 18 examples include large perforated discs (Fig.3-25;4,5), large perforated cylinders(Fig.3-25;6,7,8) , drop shaped pendants and five

"Mother-of-Pearl" beads (not illustrated).

Bangles have the highest frequency of all shell artifacts (65.8%) and of these 21 can be identified as having been made from C.ramosus. Also, there is a single fragment of a bangle made from a bivalve, probably Tivela damaoides (Fig.3-25;2). The C. ramosus and Tivela bangles were apparently brought into the site from other areas because the only bangle manufacturing waste is from the species T. pyrum.

TABLE 3-25. LOTHAL; BANGLE WIDTHS.

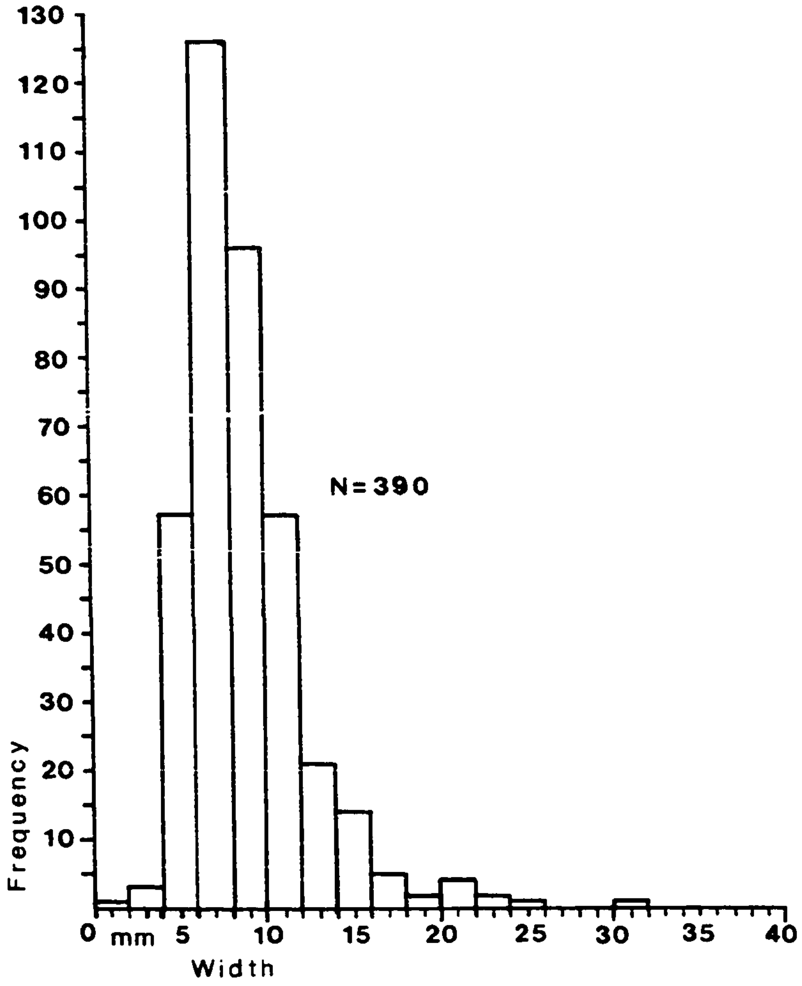


TABLE 3-26. LOTHAL; BANGLE MANUFACTURE.

	#	%
Finished	873	86.4
Unfinished	31	3.0
Man. waste	107	10.6
Total	1011	100.0

The high frequency of finished bangles could possibly be a result of finished bangles coming into the site, but actually the amount of manufacturing waste is somewhat under represented. As at Mohenjo Daro and Harappa, part of the study involved walking over the site to check and see if any quantities of shell wasters could be seen in the dumps or on the surface of the site. At Lothal, I was very surprised by the fact that no shell wasters were visible in any of the sections or eroded areas of the site, but I was even more surprised when I happened upon a large accumulation of shell debitage near the pottery sorting yard. These artifacts had evidently been discarded after having been recorded by the excavators, in much the same way that non-diagnostic potsherds are occasionally discarded. Unfortunately these wasters represent an important aspect of the bangle and the ladle manufacturing industries that were established at the site. Since it was not possible to incorporate the quantification of this material into my sample, I can only suggest that the frequency of finished bangles and wasters may be closer to what was seen at Balakot (see above). Most of the bangles are of the thin variety, and there is no

definite break indicating the production of a wide style of bangle (Table 3-25). These bangles were produced with the same basic technique that was being used at the other Indus period sites and the copper/bronze saw had a convex cutting edge that was about .5 mm thick (Appendix III:21). Incised designs on the bangles are generally of the traditional chevron motif (Fig. 3-25;1), but there are some examples of simple diagonal slashes. Other unique designs also occur and though some of these bangles may be intrusive from later historical periods, others have been found in well stratified contexts of the Late Indus occupation (Appendix III:18). Two examples have a wide squared channel around the circumference of the bangle, and on the basis of the published sections it appears that one of these bangles comes from Period A, phase III (Fig. 3-25; 3) and the other from Period B, phase IV. Although two bangle fragments do not represent an established tradition, the occurance of this design during the Late Indus phase at Lothal could be extremely significant in undertanding the continuity of shell working traditions and styles with the post-Indus and Early Historic periods. This design becomes quite common in these later periods (Chapter IV) and it is still commonly represented on shell and ivory bangles throughout the sub-continent. Another important style is a triple shallow groove, resulting in two pronounced ridges. Although the example from Lothal is from a disturbed surface context, numerous examples have been reported from Indus period

levels at the site of Surkotada (J.P. Joshi, n.p., see below). The two other designs are; circle with 3 intersecting lines or "spoked wheel", and sets of triple incised lines. These are not seen at any other Indus period sites and there is a strong possibility that they are intrusive (Rao,1979:Pl.X, note "robber pit".). Until further excavated evidence is available it would be premature to attribute these motifs to the Late Indus phase, especiall since they have been common since the Early Historic period.

Besides ornaments, the shell workers were producing numerous types of solid geometric inlay pieces similar to what was made at Mohenjo Daro, but so far, no examples of the fretted designs have been recorded. All of these pieces were probably made from T.pyrum or C.ramosus since no examples of Lambis truncata sebae or Fasciolaria trapezium have been found at the site.

Ladles were also being manufactured here, and since the source for C. ramosus is in the nearby Gulf of Kutch, it is not surprising that there is a greater frequency of manufacturing waste (48%) than what was seen at Mohenjo Daro (15%) or Harappa (30%) (Table 3-27). Keeping in mind the discovery of ladle manufacturing waste in the discarded shell material from the excavations, this frequency would be even higher. The small quantity of ladle fragments does not indicate any large scale production of these objects for trade, and we can assume that they were being made primarily

for local consumption.

TABLE 3-27. LADLE MANUFACTURE.

	#	%
Finished	16	57.2
Unfinished	4	14.2
Man. waste	8	28.6
Total	28	100.0

TABLE 3-28. OTHER ORNAMENTS, INLAY AND SPECIAL OBJECTS

	#	%
Finished	70	57.4
Unfinished	25	20.5
Other Shell	27	22.1
Total	122	100.0

In the category of special objects, there are a wide range of unique pieces made from T. pyrum or C. ramosus, but as was mentioned above, the massive L.truncata sebae was not being used as a raw material. Only one large Lambis lambis (a smaller species) has been discovered at the site, and this unworked shell was not associated with any manufacturing debitage (Rao,1979:94). Many of the special objects at Lothal were made from the thick columella of T. pyrum or its thick body whorl. These include button/studs (Fig.3-25;10,11), figurines (Fig.3-25;13) and possibly a toy cart frame (Fig.3-25;14). This last piece may be what Rao refers to as a "bridge" for a stringed instrument (1973:112). Having examined the interior edges of the

perforations, it does not appear that any form of string was supported by these holes for any length of time. Other objects similar to types found at Mohenjo Daro, include "wavey" rings (Rao,1979:105) and shell caps, of the 1/3 circle variety (Fig.3-25;12). Artifacts that do not occur at other Indus sites are the incised button seals (Fig.3-25;15,16,17) and a unique shell seal (Fig.3-25;18). The button seals may actually be ornaments, but their similarity to rectangular shell and steatite seals from Baluchistan and Southeastern Iran (Tosi,et al., 1981) suggest that they may have served as seals. The one example of a seal made from T. pyrum is a unique find. The simple hatched design is not a common motif on Indus seals, but the shape of the seal, with an unperforated boss on the back is definitely related to the Indus seals made in steatite.

Rao has interpreted the presence of shell manufacturing at Lothal as being indicative of a major industry guaged for export to the hinterland and to sites in Mesopotamia (Ibid.:236). After comparing the frequency of finished artifacts to waste it does not appear that this site was producing any massive quantities of shell artifacts. Furthermore, the contexts in which these artifacts have been found are in the habitation areas of the site and only one structure (house 157, Rao,1979:96) has been reported as containing any large quantity of shell wasters. This house is assigned to phases IV and V, during the Late Indus occupation, and numerous shell wasters and Dentalium

fragments were recovered from one of the rooms. Just down the street is another structure called a "coppersmith's workshop". A few shell bangles were found in this house too (Ibid.:95-96), but on the basis of these limited concentrations it is not possible to discuss the presence of a major industry.

One other structure that deserves mention is house 142,IIIb from Period A, phase III (Ibid.:93-94,Pl.XLIII). In this structure the Lambis lambis (Rao refers to it as a chank shell) was discovered in association with a low mud-brick platform, two grinding stones and a broken pot of Micaceous Red Ware (Rao,1961-62:9). These associated features have been interpreted as possibly representing a place of worship (Rao,1979:94) and though there is no concrete evidence to support this hypothesis, the lack of manufacturing wasters indicates that it is not a shell working area. No major concentrations of shell wasters have been reported from the earlier phases of the Mature Indus occupation, but in the course of my study I recorded 67 bangle fragments as coming from house 133. Unfortunately I have not been able to determine if this large quantity of bangles comes from the mature or late Indus occupation. No shell objects have been reported from the burials at Lothal, but it is not unlikely that when the final data is published one or two examples will turn up.

In summary, it is evident that the shell industry at the site does not represent a major production of shell

objects for export purposes. We know that there was some production at the site during the Late Indus occupation , but just how much was being made there during the Mature period, is still not certain. The general ratios of finished artifacts to waste, and the types of artifacts being produced suggests that the workshops were catering primarily to a local demand from Indus culture groups. This interpretation, however, does not rule out the possible role of the site as a gateway for external trade (Possehl,1982). Finished objects made in the rural sites located near the source of raw materials were probably being sent to Lothal or other regional urban centers for transshipment. The existence of this influx of finished artifacts is reflected in the presence of finished C. ramosus bangles. There is little question about the external contacts of the site with the Persian Gulf region and Mesopotamia (Rao,1979:222-226), but the discovery of a single bivalve (Tivela) bangle, suggests a link with the intermediate coastal sites west of the Sindhu/Nara delta. With regard to this evidence of coastal trade/exchange, it is peculiar that no L.truncata sebae or F. Trapezium have been found at the site. Why are these species found only at Mohenjo Daro and Harappa, and not at Lothal, which is closer to their source in the Gulf of Kutch or for that matter, the Gulf of Oman. One explanation would be that these species were not common in the Gulf of Kutch during the 3rd millennium B.C. and that Mohenjo Daro and Harappa had exclusive contacts with the

sources off the coast of Oman. Another interpretation of their absence could be that there was a regional preference for other raw materials and no demand for objects that had to be made from the massive Lambis shell.

Other Important Sites

Before discussing the regional patterns of the shell industry, it is necessary to look at some of the important excavated sites lying between the major centers discussed above.

About 40 km southwest of Lothal is the site of Rangpur (Rao,1963), where a long sequence of occupation provides an important reference for the cutural developments throught the Eastern coastal region. The earliest occupation at the site is of a pre-pottery microlithic culture dated to about 3000 B.C. After a brief hiatus, the Indus occupation begins and it has been divided into three phases; IIA = Mature Indus, IIB = Late Indus and IIC = Transitional. Period III the post-Indus occupation by a culture identified by its diagnostic ceramics called Lustrous Red Ware.

During the Mature Indus phase (IIA) there is evidence for the use of shell bangles with the incised chevron motif (Rao,1963:Pl.XXXVII,A), shell beads (Ibid.:Fig.145), spoons , inlay and special objects such as gamesmen and incised shell caps (Ibid.:149). Most of these objects were made from T. pyrum, but the spoons and possibly some of the bangles were made from C. ramosus (Ibid.:Pl.XXXVII,A,2 and 7). Sawn columella of T. pyrum indicate that some of the

manufacturing was being carried out at the site, but the absence of C. ramosus wasters suggests that artifacts made from this species were being produced elsewhere.

Only two bangle fragments have been reported from the transitional period II C (Rao,1963:149), but these few examples indicate a continuity of the shell working tradition with the post-Indus period III (Ibid.;Fig.145). This relationship is important for understanding the continuity of shell working technologies with Early Historic and Medieval periods in this region.

Proceeding to the northwestern tip of Kathiawar, the recently discovered site of Nageshwar provides another important perspective of the shell industry (Bhan and Kenoyer,1983). This site is located on the southern shore of the Gulf of Kutch about 17 km northeast of Dwarka (22°20' N.Lat.,69°6' E.Long.) (Fig.3-26). A rough estimate of the total exposed site is 250 by 300 meters, but much of the deposit has been removed by contractors who are building a nearby dam. In the process of their excavations they have uncovered what appears to have been a major manufacturing center for the production of shell bangles and shell ladles. Pottery associated with the deposits indicate that this was a single period site of the Mature Indus period and comparable to Rangpur, Period IIA and Lothal A,II-III (Ibid.). A preliminary estimate of the date would be between 2450 to 1900 B.C., with possibly some overlap into the Late Indus period.

On the basis of our surface surveys, shell bangles appear to have been made primarily from Turbinella pyrum and less commonly from Chicoreus ramosus (Fig.3-27;4). Relatively few finished bangles have been recovered, but some of these were incised with the diagnostic chevron motif (Fig.3-27;1,2). Vast quantities of wasters were found in the pits exposed by the contractors (Fig.3-27;4 to 7) and in one such pit they encountered so many columella of T. pyrum that they had to stop digging. Evidently this material was not suitable for building a dam. In this pit there were literally hundreds of chipped and sawn columella all heaped in one pile (about one square meter), more than have been recovered from the entire excavations at Mohenjo Daro (about 110). This cache of wasters may have been intended for reprocessing into other solid objects, but we found no evidence for the manufacture of anything but bangles and ladles. A preliminary analysis of the saw cuts on the wasters indicates that the saw was about 1 mm thick and had a convex cutting edge like those used at the other urban centers.

Another significant feature of the site was the production of shell ladles from C. ramosus. In the course of two different surveys, numerous unfinished ladles and manufacturing waste was recovered, but not a single piece of a finished ladle was found. Until extensive excavations have been carried out we will not know if this absence of finished ladles and the low frequencey of finished bangles

is representative of the rest of the site, however, the present implications are that bangles and ladles were not being made for use at the site itself. These objects were evidently being manufactured exclusively for trade to the major urban centers in the Eastern region and the nuclear region of the Sindhu/Nara plain. Proposed excavations by the Department of Archaeology, Maharaja Sayaji Rao University , Baroda will hopefully provide further information on this important aspect of economy and tradition during the Indus period.

One other site in this region that deserves special mention is the fortified Indus settlement at Surkotada, in the eastern part of Kutch. The Indus occupation is represented by three phases; IA,IB and IC (Joshi,1972:120). In the earliest levels there is a mixture of the mature Indus artifacts with pottery of a local antecedant culture, and though the Indus artifacts continue throughout, each following phase shows contacts with some other local tradition. On the basis of several C14 dates, the occupation is dated from 2100 to 1700 B.C., which is well within the general span of the Indus civilization; 2500 to 1750 B.C.(Joshi,1972:137). Although I have not been able to study any of the artifacts from the site, the excavator (J.P.Joshi) has kindly permitted me to refer to his analysis of the shell artifacts in his unpublished final report (Joshi,n.p.)

Quite a number of bangles were recovered from the

excavation, and 94 have been recorded from the earliest phase IA. These are generally of the thin variety and have a chevron design incised over the suture (Joshi,n.p.:489). Numerous fragments of sawn manufacturing waste have also been recovered, but I'm not sure if these are found in all phases or not. In Phases B and C thin bangles continue to be found, but wide bangles with shallow or deep grooves also occur. Various sections of wide and grooved bangles are illustrated below (Table 3-29).

TABLE 3-29. SURKOTADA; WIDE AND GROOVED BANGLE SECTIONS.

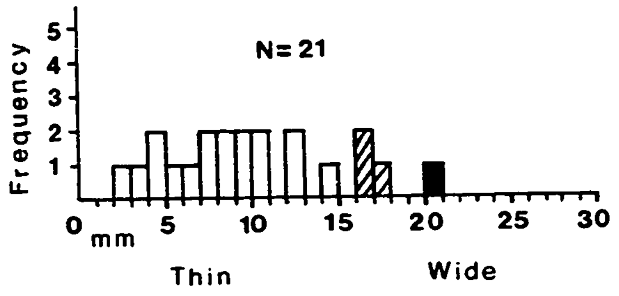
1. a) Single ridge.
   b) Single ridge.
2. Double, wide groove.
3. Triple, wide groove.
4. Multiple, wide groove.
5. Double, deep groove.
6. Triple, deep groove.
7. Multiple, deep groove.

Some geometrical designs have also been reported, but I was unable to examine any of the motifs or determine what contexts they were from. The presence of wide grooved bangles, however, is well documented and therefore extremely important because of their rare occurance at other contemporaneous sites. Variety 1 of course is common at most Indus sites, but variety 3 is seen only at Lothal. Deep grooved bangles have not been reported from any Mature

Indus sites, and the only other parallels are from the Early Chalcolithic period at Mehrgarh (Period III) and from the Early Indus levels at Gumla (Period III). Because of the disparity in chronology and the distance between these sites it is unlikely that there is any connection, especially since we have no evidence of contact between these regions prior to the Mature Indus period. Until further stratigraphic evidence is available, the evidence from Surkotada is that grooved bangles are characteristic of the late phase of the Indus culture and are a regional style limited Kutch and possibly Kathiawar. The contexts for shell artifacts at Surkotada are limited to habitational areas, and no shell has been reported from the four burials (Joshi,1972:126-127).

Returning now to the Lower Sindhu/Nara Plain, at the site of Amri we see a definite change in the shell industry in the Mature Indus period (Amri, Period III,A B,C) (Appendix III:3). During the previous period only ornaments such as bangles, beads and rings were being made, but now we see evidence for the manufacture of ladles from _C. ramosus_ and possibly inlay from _L. truncata sebae_. _Turbinella pyrum_ continues to be used for bangle manufacture, but there is a marked decrease in bangle widths (mean = 9.5 mm) and the frequency of wide bangles (Table 3-30). This pattern is even further accentuated in the sample of bangles found from surface contexts or related to the late "Jhangar" occupation in Period V (Table 3-31).

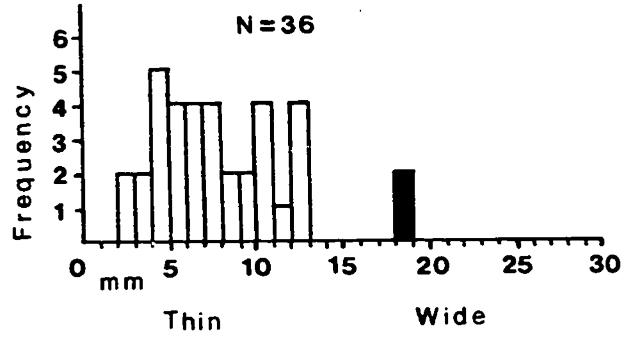
TABLE 3-30. AMRI; BANGLE WIDTHS, PERIOD III.



N= 21 mean = 9.5 s.d.= 4.9 min= 2.5

max= 20.

TABLE 3-31. AMRI; BANGLE WIDTHS, PERIOD V AND SURFACE.



N= 36 mean = 7.5 s.d.= 3.6 min= 2.8

max= 18.

Although thin bangles definitely represent a stylistic preference, the technological development of a special copper/bronze saw is also an important factor behind their occurance during the Mature Indus period. Because of its long sequence, Amri is one of the only sites where we can see this change in stylistc preferences closely tied to developments in technology.

During the Mature period there is a dramatic increase

in settlements on the Sindhu/Nara plain, and the important site of Chanhu Daro was located just on the other side of the river from Amri. This site is smaller than Amri and consist of three low mounds (about 6.5 hectares). A deep cutting reaching to the water table revealed the presence of five major occupation phases during the Indus period, with the uppermost levels being mixed with Late Indus or "Jhukar" cultural materials (Mackay,1943). Shell artifacts were recovered from the lowest excavated levels and one of these was an exquisitely carved container (Mackay,1943:Pl.XC,19-21). This container was made from a large Chicoreus ramosus that had been hollowed out and carved on the exterior. The carved motif is of a gharial, but due to the irregular thickness of the shell, only the snout and two feet could be carved from the solid spires. Other parts of the body were evidently carved separately and attached to the exterior of the shell. An object that Mackay could not identify is pictured just above the container (Ibid.:16) and may be the tail for a similar composite carved figurine.

Most of the evidence for shell working comes from phase II of the Indus occupation (numbered from I to V starting from the surface). Numerous other industries were being carried out at the site and Mackay does not feel that shell working played any significant role since manufacturing was limited to the northern part of mound II (Mackay,1943:53,192). The most common species represented

is C. ramosus and not T. pyrum. However, bangles were being made from both species and founr unfinished C. ramosus were found together near apossible workshop (Ibid.:43, Pl.XC,15). Two grooved bangles have also been recovered from the late "Jhukar" levels (Ibid.:Pl. LXXVII,6,7), and though they may have some connection with the traditions during the Late Indus period in Kutch, the designs are quite different.

Ladles were quite common at Chanhu Daro and the presence of numerous whole C. ramosus, sawn wasters and unfinished ladles indicates that they were being produced at the site. Most of thes were made in the standard shape with a handle, but there is one example of a simple shallow dish (Ibid.:PL.XC,6,13,14,17). Inlay was fairly rare at the site and though special objects such as shell caps (1/3 circle variety) and carved figurines do occur (Ibid.:Pl.XC), Mackay interprests this as and indicator that the inhabitants were to poor to indulge in the luxury of inlaid objects (Ibid.:232). Another interesting artifact is what Mackay refers to as shallow dishes (Ibid:Pl.XC,3,4,9,10). I was able to examine one of these at the Museum of Fine Arts in Boston and on the interior concave surface are two small depressions. Similar pieces have been found at Mohenjo Daro and I have identified them as being the hand held backing for a bow drill (Kenoyer,1983,in press). All of the ones from Chanhu Daro come from areas associated with industrial activities such as bead making, carpentry, metal working,

shell working, seal cutting, etc, so we can assume that most of these small "dishes" were actually used as drill backs. One of the most intriguing artifacts is the incised "libation vessel", or as Mackay calls it "feeding cup" (Ibid:231-232,Pl.XC,2). He says that it is made from C. ramosus, but its well balanced fusiform structure and the shape of the anterior channel are not characteristic of this species and it may be of another species, either Turbinella pyrum or possibly Fasciolaria trapezium, since this species has been identified at the site (Mackay,1943:249). This object was found in locus 215 , in a structure on the southern part of mound II (Mackay,1943:Pl.IV). Mackay regards these structures as relating to bead manufacturing (Ibid.:53) and other associated objects include a decorated carnelian bead, an ivory peg and a copper knife (Ibid.:Pl.LXXXIX,2,7; Pl.LXX,24). Unfortunately, none of these artifacts or their context provide any further clue to the possible function of this object.

Our overall impression of the site, especially mound II, phase II is of a small settlement of specialized artisans who were producing a large variety of goods for a diverse market within the Lower Sindhu/Nara plain. One interesting feature that may provide some clue to the background of this settlement, is that unlike other sites in this region, most of the shell artifacts were being made from C. ramosus and coincidentaly, long carnelian beads were also being made at the site. Both of the necessary raw

materials are common in the Eastern region, and the implications are that these artisans had strong economic or social contacts with the Gulf of Kutch and were therefore not using the raw materials available from the nearby Kohistan (carnelian) or the Western coast (T.pyrum).

Continuing up the Sindhu/Nara plain, we come once again to the site of Kot Diji, where we see a continuity from the Early to the Mature Indus period. Unlike the pattern seen at Amri, there is no change in the with of bangles between these two periods (Table 3-32). This lack of variation further demonstrates the continuities between the late Early Indus levels and the fully developed technology and styles of the Mature Indus period.

TABLE 3-32. KOT DIJI; BANGLE WIDTHS, MATURE INDUS PERIOD.

N= 17	mean = 5.1 mm	s.d.= .27	min= 2 mm
			max= 11.3 mm

No bangle manufacturing waste has been recorded and yet the presence of one unfinished bangle (T.pyrum) suggests that some of the processing may have been done at the site. One sawn fragment of C. ramosus and one of L.truncata sebae lend further support to the presence shell working at the site, but the following statement by the excavator would indicate that this industry was quite limited. "Except for a few shell bangles and beads, a large antler of a deer and one or two mother-of-pearl shells, no other object has been

observed." (Khan,1965:83). The mother-of-pearl shells referred to are fresh water mussels (Lamellidens marginalis) and not the marine Pinctada. Many of these mussels have been used as scrapers and others were perforated at the umbo, possibly for use as crude pendants.

Further north along the Nara Nadi system, a large number of Early Indus and Mature Indus settlements have been discovered along dried up river beads in the Cholistan desert (Mughal,1982). Raw materials passing along the trade/exchange networks connecting Mohenjo Daro with Harappa and Kalibangan, may have passed through many of the larger sites, such as Ganweriwala and Kudwala. If this were the case, then we should see evidence of shell working or finished objects similar to what has been noted from Mohenjo Daro and Harappa. Mughal has kindly allowed me to examine the artifacts from his surface collections, and it appears that most of the Mature Indus sites (identified as such on the basis of diagnostic ceramics) have the traditional incised bangles made from both T. pyrum and C. ramosus. These sites include Ganweriwala, Sandanawala, Barriwala Ther, Bazariwala and Kudwala. At this last site a C. ramosus ladle fragment was also recovered, but all of the artifacts finished pieces and no evidence for manufacturing has turned up yet. The absence of raw materials and manufacturing at these sites would imply that although these settlements were recieving some finished goods from the urban sites, they didn't have access to shell raw materials

coming from the coast, particularly species from the distant coast of Oman.

At Kalibangan, which is further north along the same river system, there is very little information to work with. Shell ornaments are reportedly found in the habitation areas of the site during the Mature Indus occupation, but there is no mention of whether any manufacturing waste has been found or not (IAR,1964-65:38; 1960-61, etc.) I was unable to visit the site, so there is not much more I can add. Some shell ornaments have been reported from the Indus period burials, and in Grave 26 a large shell ring (6.5cm diameter) was found near the left ear (IAR,1964-65:38). Bangle fragments have also been found with steatite disc beads, a carnelian bead and pottery offering in a grave that contained no skeletal material (Ibid.). One other Indus period cemetery has been excavated at Ropar (Sharma,1955-1956) and here too, shell bangle fragments have been found in extended burials. However, these scattered occurances of shell in various types of burials do not seem to indicate that shell ornaments were important as funerary objects.

Peripheral Regions

The dramatic increase in shell manufacturing during the Mature Indus period appears to have been primarily directed towards supplying markets within the Sindhu/Nara region and the adjacent peripheral regions. There is little or no evidence for the use of shell in Baluchistan, Afghanistan,

Rajasthan or the inland regions of Gujarat. In fact, shell artifacts are only seen at those border sites which also have other diagnostic Indus artifacts. Some examples are seen at Periano Ghundai (Stein,1929:37), Gumla (Dani,1970-71:Pl.44,8) and Pathani Damb I (De Cardi,1964:25). Further north in the Jhelum region, Stein recovered a few shell bangle fragments at sites roughly dated to the late 3rd and early 2nd millennium B.C., such as Rattapind, Bahur A, Machar Khadi, etc (Stein,1967; personal study of his collections in the Peabody Museum). One exception is seen at the site of Shortugai, located on the Amu Darya (Oxus River) in Northern Afghanistan (Francfort and Pottier,1978). Several shell bangles (T. pyrum) have been recovered from the Mature Indus occupation levels, but no manufacturing wasters have been found (Francfort, pers. communication). These bangles wer undoubtedly brought to the site by the Indus settlers/merchants for their own personal use and not for trade. Other sites in the highland regions of Baluchistan show little or no contact with the Sindhu/Nara region during this period, and consequently there is an absence of shell artifacts. Shahr-i Sokhta is the only other exception, and T.pyrum bangle fragments and wasters have been found on the surface associated with deposits from periods II and III (discussed above). Looking to the southeast, we see a similar pattern, with shell bangles and other artifacts occuring at the peripheral Indus sites, for example at Bhagatrav (IAR,1957-58:14-15).

Further inland at the isolated site of Daimabad on the Godavari River only a single shell bangle fragment has been reported from the Indus period III (Sali, 1982:181).

Summary

Following this detailed discussion of the context and nature of shell industries during the Mature Indus period, several important features can be pointed out regarding its role in the Indus Civilization. First, a new set of raw materials was being used that was not seen in the Early Indus period. These primary raw materials, *Turbinella pyrum*, *Chicoreus ramosus*, *Lambis truncata sebae* and *Fasciolaria trapezium* were being procured from three distinct resource areas (Fig.3-28). *T. pyrum* was being obtained from the Western coast along with various other secondary species, while the Eastern coast (Gulf of Kutch) provided both *T. pyrum* and *C. ramosus*. The absence of *L. truncata sebae* and *F. trapezium* from sites in Kathiawar suggests that these species were not common or at least not collected from the Gulf of Kutch. A third source on the coast of Oman (or possibly the Arabian/Persian Gulf) was supplying both of these species to Mohenjo Daro and Harappa, but not to the other manufacturing centers. Only one example of *L.truncata sebae* has been found at Amri and one at Kot Diji. At the site of Chanhu Daro and Balakot, single examples of *Fasciolaria trapezium* have been found. On the basis of this distribution, we can postulate a complex hierarchy of interaction spheres and trade systems within

the Sindhu/Nara region. The major urban center of Mohenjo Daro had direct contact with distant coastal resources and these primary raw materials were distributed further inland to the site of Harappa. A decrease in the quantity of primary raw materials and the variety of secondary species has been noted at the site of Harappa, and this can be attributed to its greater distance from the source and the intervening transshipment at Mohenjo Daro. Smaller urban sites in the Lower Sindhu/Nara plain and along the Western coast had access only to those species available from the Eastern and Western seaboard. This access was limited to semi-finished or finished artifacts, as in the case of C.ramosus ladles at Balakot and Allahdino. In the Eastern region most sites had access to both T.pyrum and C.ramosus, but there was evidently some contact with the Westen coast since one Tivela bangle fragment has been found at Lothal.

Stratification in the trade of raw materials and the movement of finished goods is also reflected in the shell industry. Different types of shell working techniques were necessary to produce various objects, and at each site, the role of this industry is slightly different. Nonetheless, an overall pattern can be seen in the industry at the major urban centers such as Mohenjo Daro, Chanhu Daro, Harappa, and Lothal. At these sites we see a wide variety of objects being produced primarily for markets within the city or at the most for nearby rural sites, e.g. Cholistan sites. Smaller rural or coastal sites like Allahdino, Balakot and

Nageshwar produced only a limited range of artifacts. At Balakot the intensive production of Tivela bangles appears to have been guaged towards a limited regional market along the Western coast, while at Allahdino, bangles were being made specifically for the local inhabitants. Nageshwar, however, seems to have been specialized in the production of bangles and ladles primarily for trade to regional and extra-regional markets.

In contrast to this specialization between sites, the manufacturing technology was quite standardized. A specific technique for chipping and cutting the shells was used in all of the distant workshops and even the width of the copper/bronze saw blade was identical. Although there was some regional variation in the widths of bangles, they were all incised with the same chevron motif, and this tradition continued throughout the Mature Indus period. The only change in this style is seen during the Late Indus period at the sites in Kutch and Kathiawar. Other artifacts such as ladles, shell caps, gaming pieces and even inlay designs show a remarkable uniformity between the distant regions.

These similarities in artifact types and style of decoration undoubtedly reflect specific uses related to the common cultural and socio-ritual role of shell objects. The question remains, how can we better understand these cultural traditions ? Shell artifacts have been found in basically every imaginable context; from dumps to habitation areas, on sculptures and in burials. No pattern has been

discernable in their occurance in burials, so we can assume that their association with other funerary offerings is more or less coincidental. Bangles, beads, pendants and perforated discs etc. were undoubtedly used for personal adornment, but was their use related to a culturally defined socio-ritual quality of the shell, or was it simple vanity? Ladles made from the spine covered C. ramosus required an unproportionate amount of labour for use as domestic utensils, and yet their occurance at almost every Indus site indicates that someone or some group of people required them. Were they used by affluent individuals as symbols of status and wealth, or did they function in some specific ritual. Imitations made in clay suggest that that they were of considerable value and in high demand. Similar questions can be raised regarding the finely incised shell containers or "Libation" vessels from Mohenjo Daro and Chanhu Daro, and the possible Indus period trumpet from Harappa.

Other important socio-economic questions can be raised from our observations of varied levels in production and overlapping but distinct trade/exchange networks. What groups were involved in the collection of raw materials and were they related to the artisans who manufactured the shell objects? How was the inter-regional movement of raw materials and finished goods being regulated and who controlled the exclusive access to exotic marine commodities? Some of these questions could possibly be answered on the basis of accepted assumptions relating to

the nature of urban societies and specialized industry, but the reliability of such assumptions are questionable unless we can compare them to known patterns in similar contexts. As was pointed out in the introduction, shell objects identical to those used in the Indus Civilization are still being made and used in South Asia today. Some of the traditions surrounding their manufacture and use can be traced back to early literary sources or folk epics, while other evidence is seen in historical archaeological contexts. In the following chapter we will examine some of the continuities and discontinuities in the use of shell after the decline of the Indus Civilization, and then attempt to answer some of the questions raised above.

Abbreviations of Site Names

Each illustration is accompanied by an artifact description and when available, an artifact number. The site and provenience abbreviations are generally self explanatory, but since some are less clear, all have been listed below.

MR = Mehrgarh AiA = Amri

SKH = Sarai Khola SRG = Lothal (Saragwala)

BLK = Balakot MD = Mohenjo Daro

At Mohenjo Daro and Harappa the early excavators gave sequential numbers to artifacts according to the general area of excavation; i.e. L = L Area, HR = HR Area etc. When these artifacts were distributed to various they were often given new accession numbers, i.e.

MM = Mohenjo Daro Museum HM = Harappa Museum

LM = Lahore Museum PWM = Prince of Wales Museum

IMC = Indian Museum-Calcutta etc.

The numbering system used during the surface survey included the site, the year and the sequential number, i.e. MD/83/217

MD = surface, provenience unknown

MN = Moneer Area L = L Area HRE = HR Area, east etc.

FIGURE 3-1. MEHRGARH; SHELL ARTIFACTS.

Period I (1-14) Aceramic Neolithic

1. Bracelet,plain, Turbinella pyrum
   Mr 3: Locus 21/3437
2. Bead, short truncated bicone, species?
   Bead, short oblate, species?
   Bead, cylinder disc, species?
   MR 3: T.121,387/13
3. Bead, cylinder disc, Spondylus exilis
   MR 3: Loc. 261
4. Bead, cylinder disc, Spondylus exilis
   MR 3: 722.1
5. Bead, cylinder disc, Spondylus exilis
   MR 3: C5H, T.120,387/6,3485
6. Bead, standard cylinder, species?
   MR 3: 133, 399/4
7. Bead, long cylinder, gastropod sp.?
   4 Beads, cylinder disc, Spondylus exilis
   MR 3 T: Loc. 21,544,1/3436
8. Pendant, convex-concave, Spondylus exilis
   MR 3:C58, T.121,387/9,3489
9. Pendant, flat diamond, Pinctada, sp.
   MR 3: 736.1
10. Pendant, perforated shell, Cardium assimile
    MR 3 T: 522. Loc.5, 3285
11. Bead, tabular hexagon, Cardium/Arca, sp.?
    MR 3 F: D2F, Homo 14
12. Bead, tabular hexagon, Cardium/Arca, sp.?
    MR 3: C2J T. 12/5,900/2
13. Bead, tabular hexagon, Cardium/Arca, sp.?
    MR 3: C5H, T.121 387/10, 3494
14. Pendant, tabular hexagon, Conus, sp.
    MR 3, no number

Period II (15-16) Neolithic

15. Chipped columella, Strombus, sp.
    MR 4: F5B, 10-27
16. Perforated columella, Strombus, sp.
    MR 4: F5B, 31-2
17. Heavily worn columella fragment, Strombus, sp.
    MR 4: F5B, (3) P.118
18. Inlay?, species ?
    MR 4: F6B, (1) 10-2
19. Bead, tabular hexagon, Cardium/Arca, sp.?
    MR 4: F6B (3)

Period III (17-20) Neolithic to Early Chalcolithic

20. Sawn anterior, Turbinella pyrum
    MR 2: F'
21. Sawn anterior, Turbinella pyrum
    MR 2: F'
22. Grooved Bangle, triple ridge, Turbinella pyrum
    MR 2: F'
23. Grooved Bangle, double ridge, Turbinella pyrum
    MR 2: surface

FIGURE 3-1. MEHRGARH; SHELL ARTIFACTS.

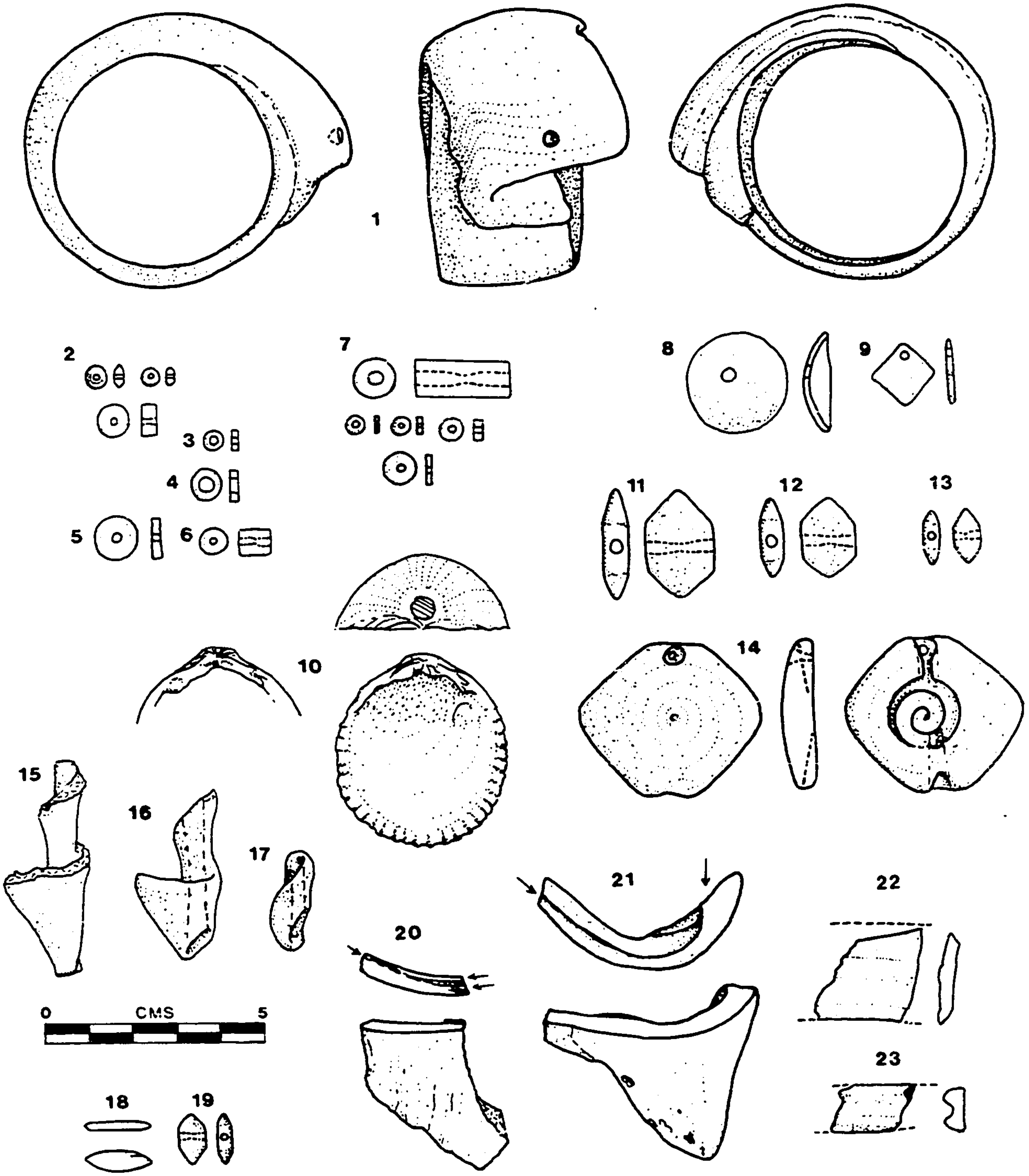


FIGURE 3-2. MAJOR TRADE/EXCHANGE NETWORKS FOR SHELL, 7TH TO 4TH MILLENNIA B.C.

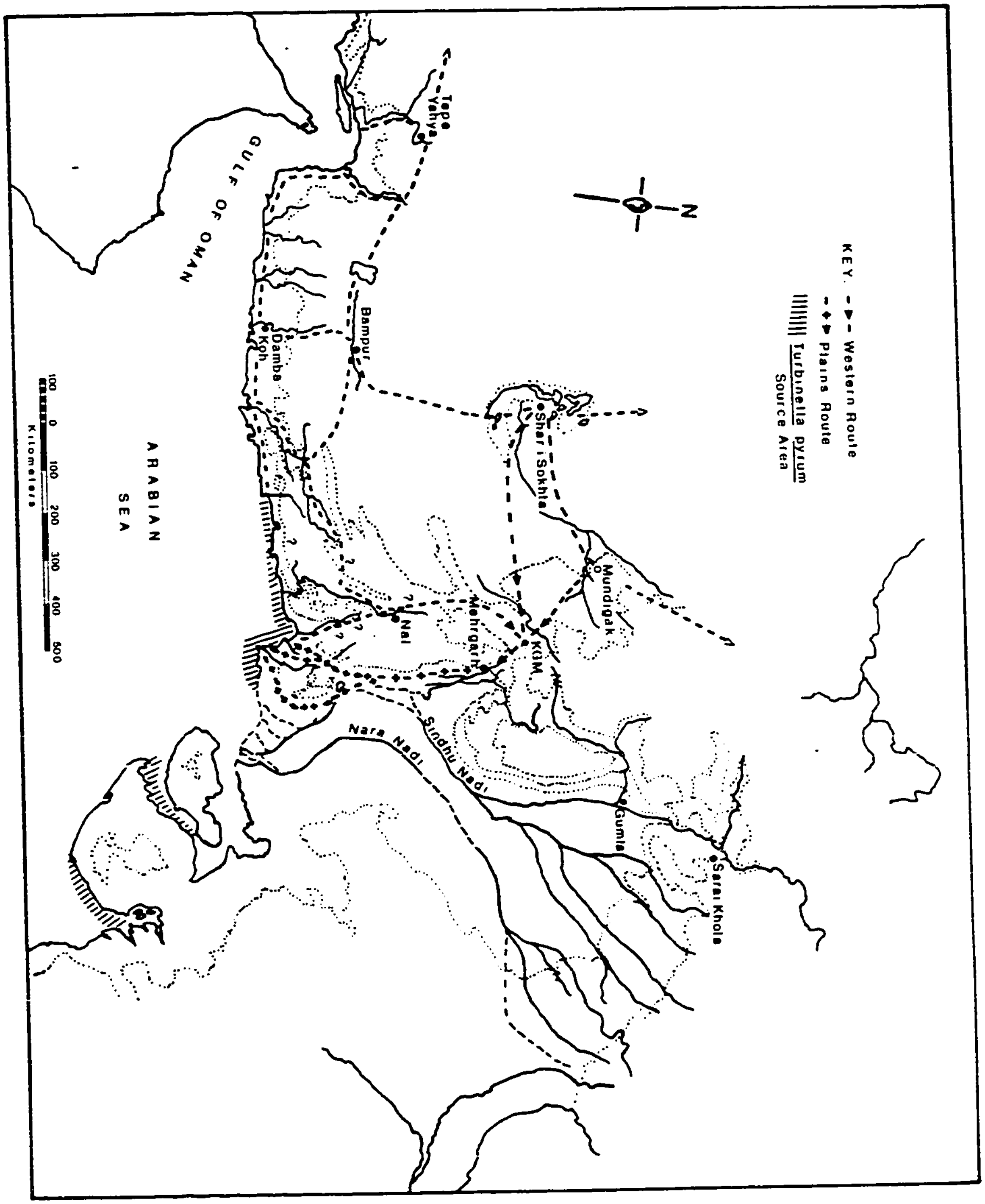


FIGURE 3-3. AMRI; SHELL ARTIFACTS.

1. Bangle, plain, *Turbinella pyrum*
   Period IIIC: AiA 25 (11) 111/1
2. Bangle, incised chevron, *Turbinella pyrum*
   Period ?: AiA (24) Ph.2/2/2
3. Bangle, incised chevron, *Turbinella pyrum*
   Period IIIC: AiA 14 69 (10)
4. Bangle, single groove, *Turbinella pyrum*
   ? AiA ? no number
5. Bangle, plain, *Turbinella pyrum*
   Period IIB: AiA 25 (15)
6. Bangle, plain, *Turbinella pyrum*
   Period I: AiA 24 (28)
7. Bangle, wide convex, *Turbinella pyrum*
   Period I: AiA 194 (21) Ph.
8. Bangle, plain, *Turbinella pyrum*
   Period ?: AiA Ch,VII 264/1
9. Bangle, wide, repaired, *Turbinella pyrum*
   Period I: AiA 24 (29) 2321
10. Bangle, wide, repaired, *Turbinella pyrum*
    Period I: AiA 23 (33) 2551
11. Columella, sawn and ground , *Turbinella pyrum*
    Period IIIC: AiA 13 (10)
12. Ring, unfinished, *Turbinella pyrum*
    Period I: AiA 25 (32)
13. Ring, unfinished, *Turbinella pyrum*
    Period I: AiA-010 (32)
14. Ring, finished, *Turbinella pyrum*
    Period VA: AiA-11 (6a)

FIGURE 3-3. AMRI; SHELL ARTIFACTS.

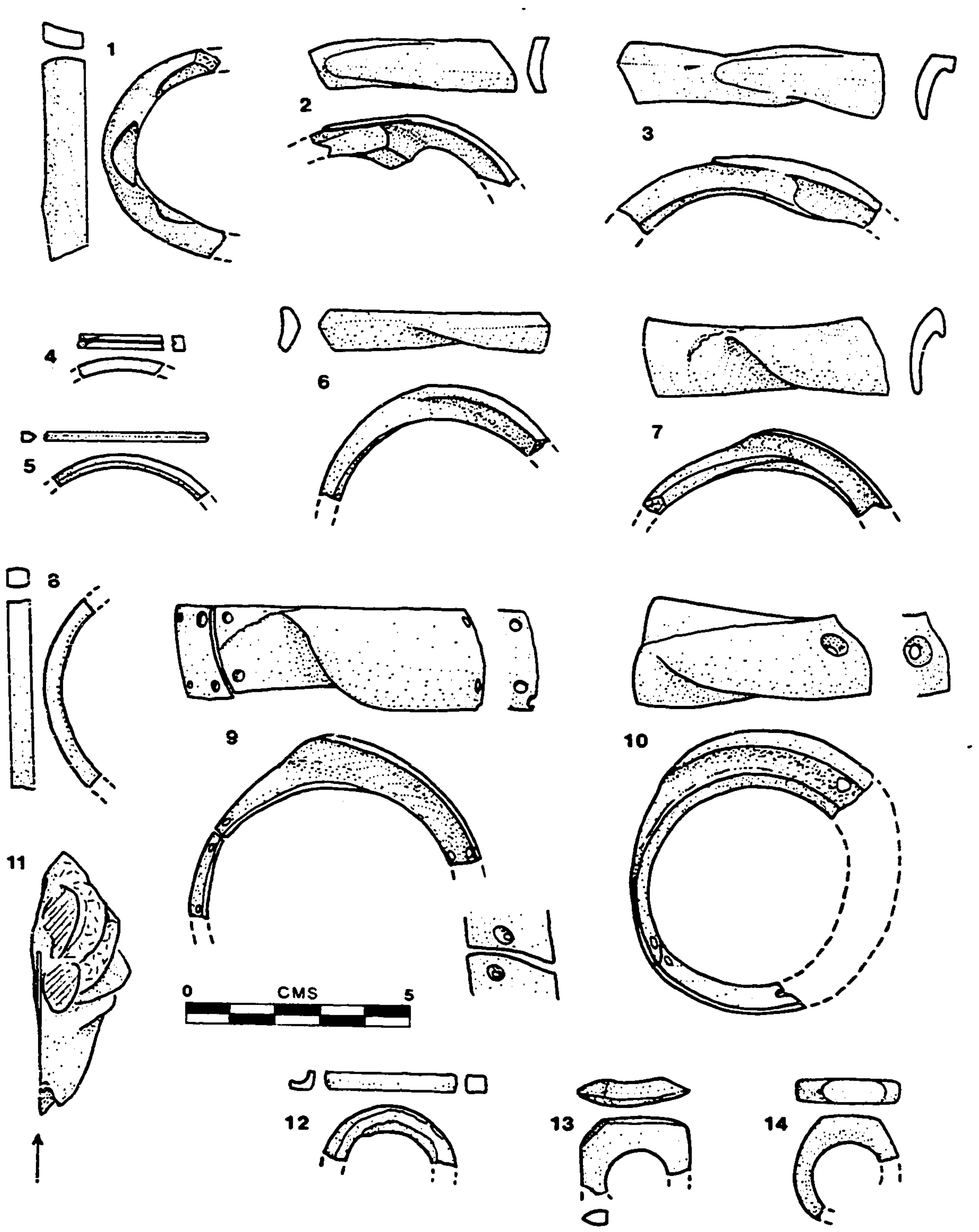


FIGURE 3-4. SARAI KHOLA; SHELL ARTIFACTS.

Period II, (1) Kot Dijian

1. Bangle, plain, _Turbinella pyrum_
   SKH 625

Period IV and Surface (2-9) Early Medeival

2. Bangle, concave section, _Turbinella pyrum_
   SKH 705,III top soil
3. Bangle, incised parallel lines, _Turbinella pyrum_
   SKH ,I Pit 699, P.IV
4. Bangle, wide, channel section, _Turbinella pyrum_
   SKH, O, 85
5. Bangle, incised design, _Turbinella pyrum_
   SKH 292
6. Bangle, incised design, _Turbinella pyrum_
   SKH 307
7. Pendant,carved, _Turbinella pyrum_ ?
   SKH 376
8. Bangle, wide, double channel, _Turbinella pyrum_
   SKH 244,18/E (2) Pit
9. Bangle, wide, convex section, _Turbinella pyrum_
   SKH 122,(2)

FIGURE 3-4. SARAI KHOLA; SHELL ARTIFACTS.

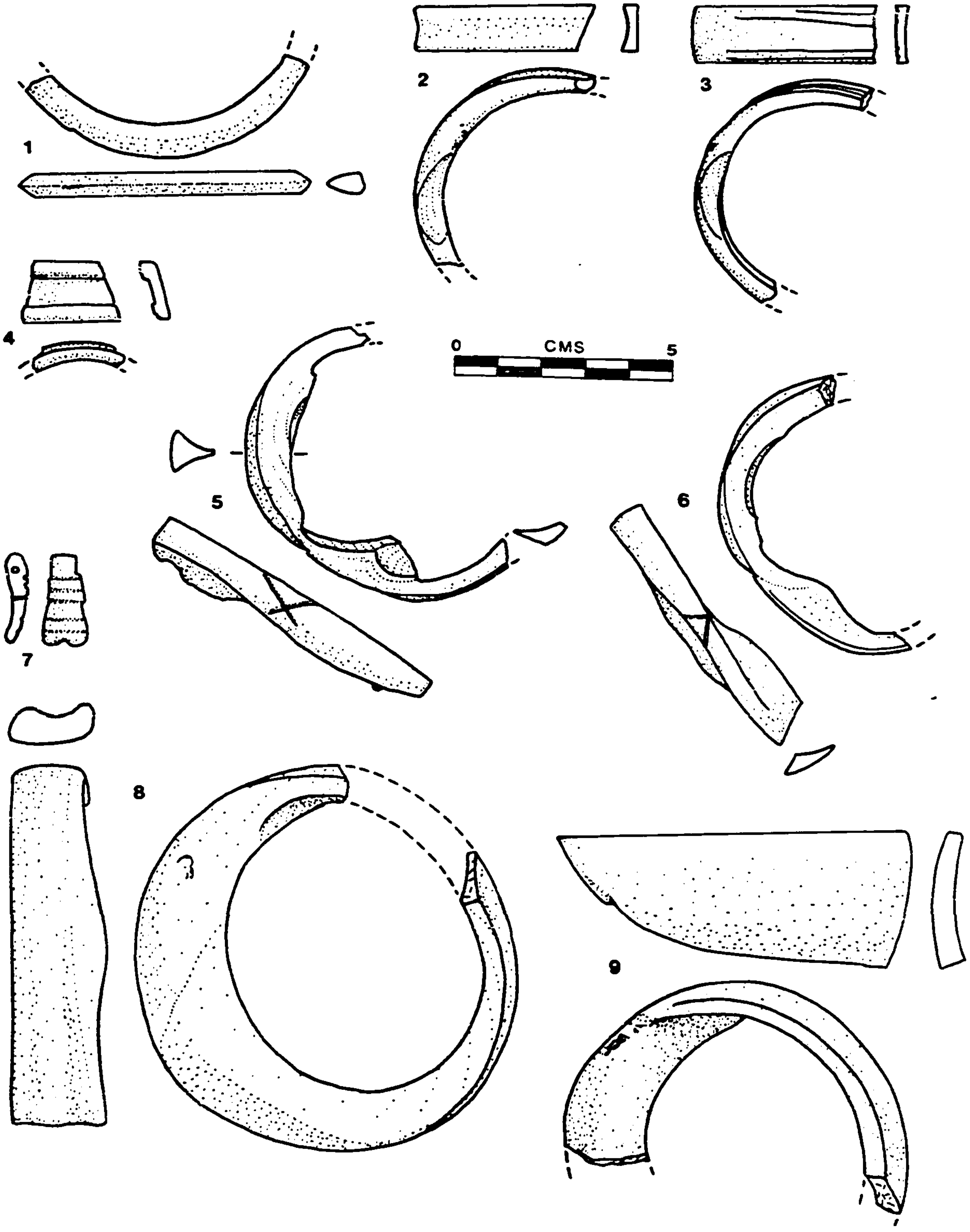


FIGURE 3-5. MAJOR TRADE/EXCHANGE NETWORKS FOR SHELL,
4TH TO EARLY 3RD MILLENNIUM B.C.

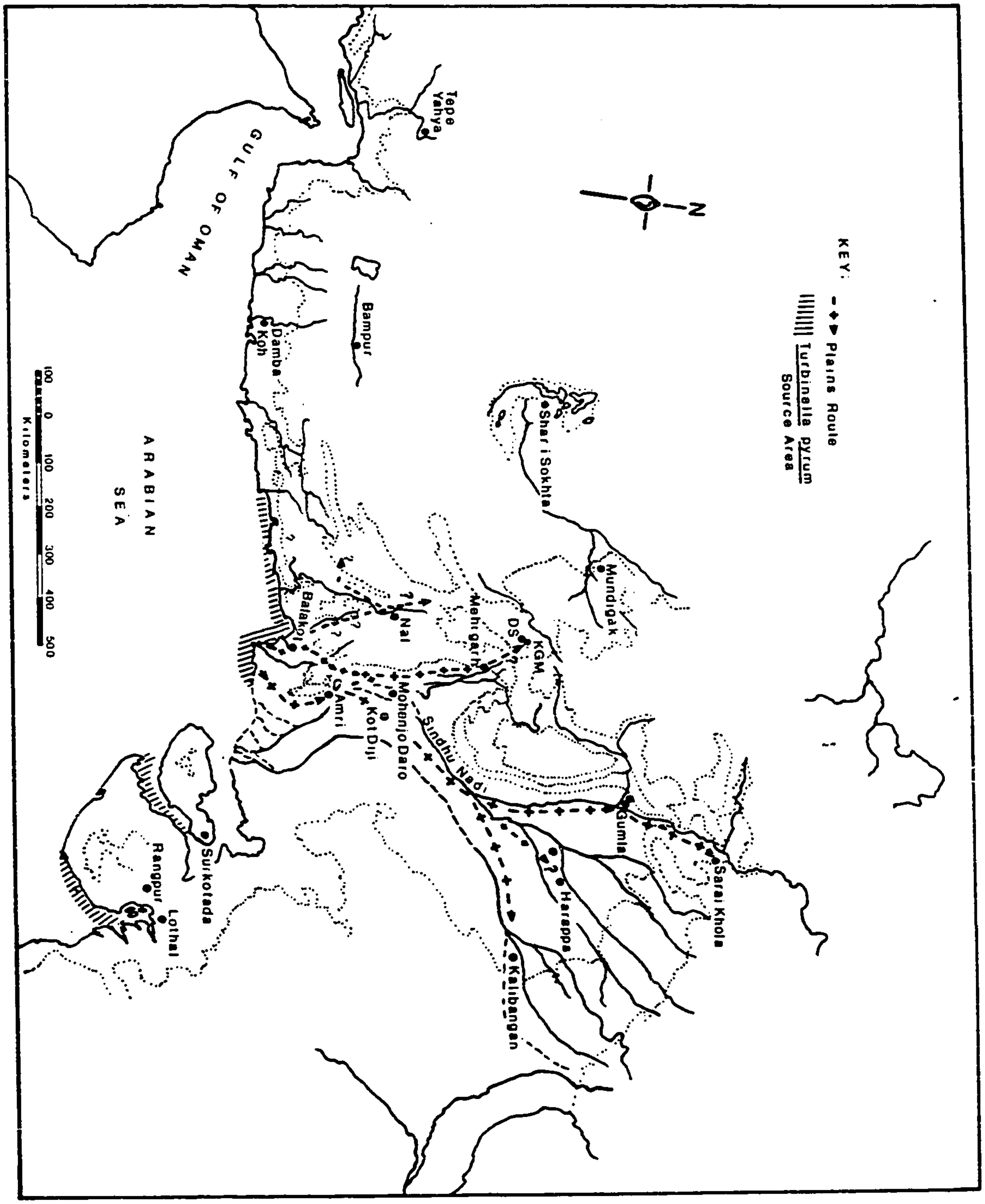


FIGURE 3-6. BANGLE MANUFACTURE WITH Turbinella pyrum.

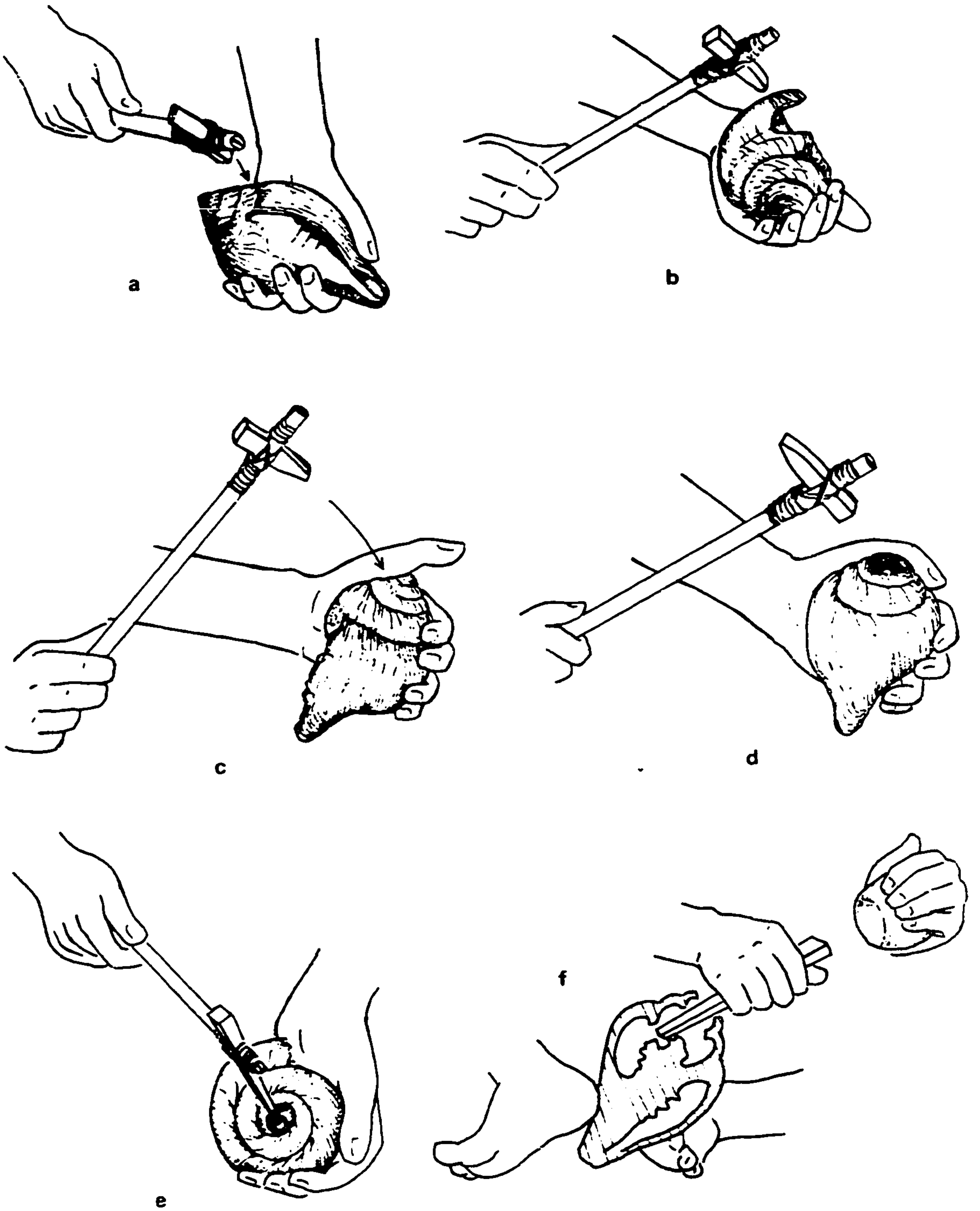


FIGURE 3-6. BANGLE MANUFACTURE WITH <u>Turbinella pyrum</u>.

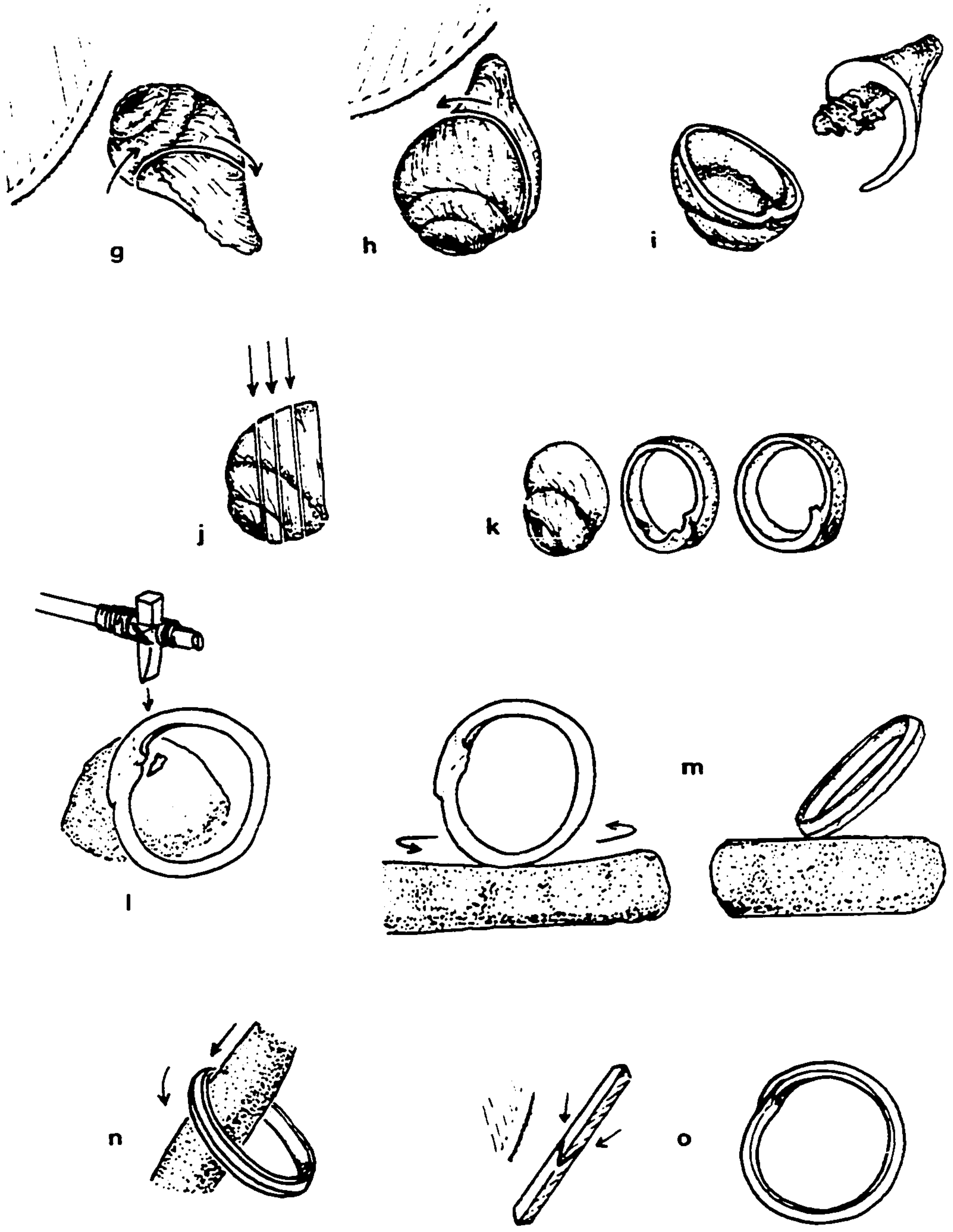


FIGURE 3-7. LADLE MANUFACTURE WITH Chicoreus ramosus.

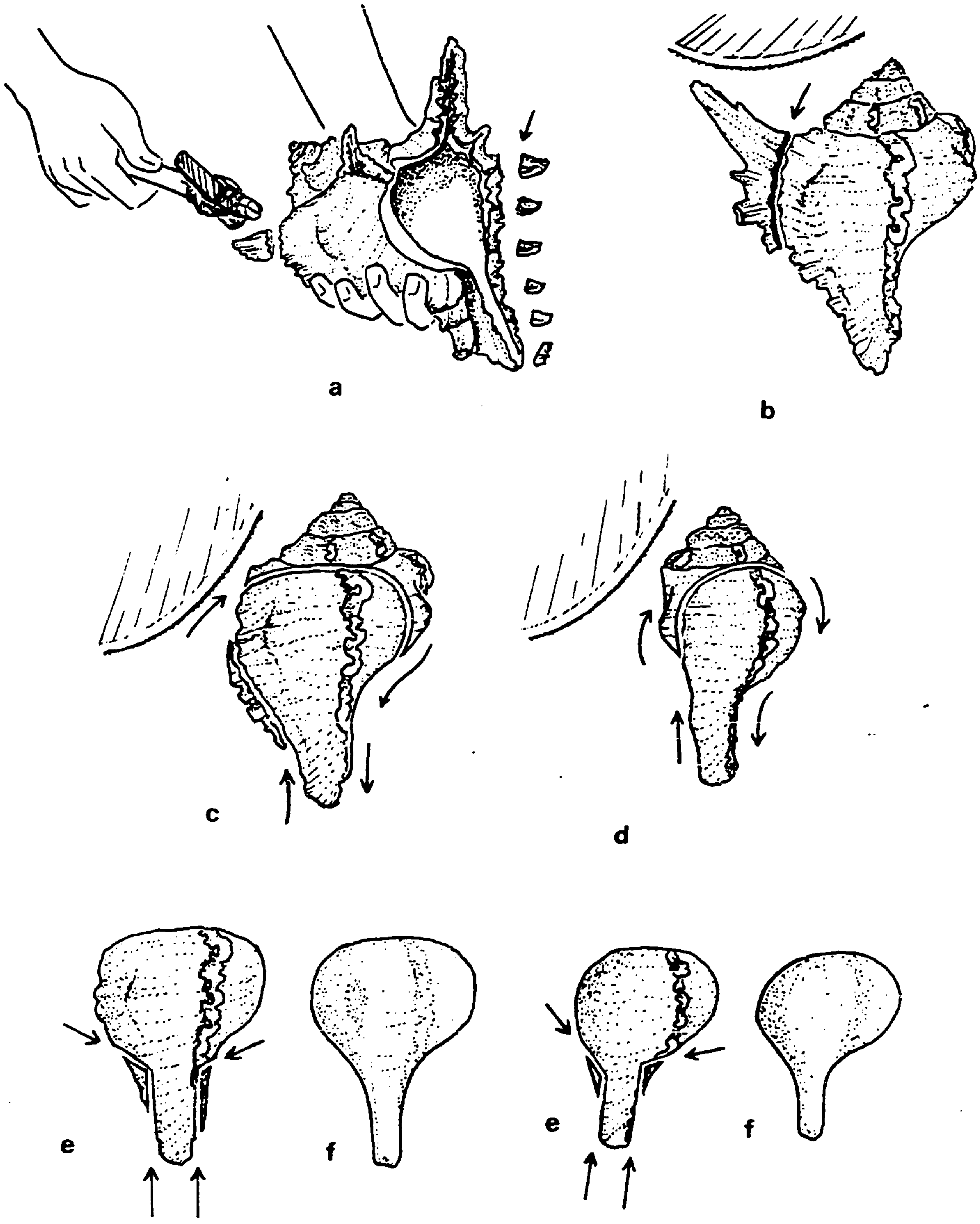


FIGURE 3-8. INLAY MANUFACTURE WITH Lambis truncata sebae.

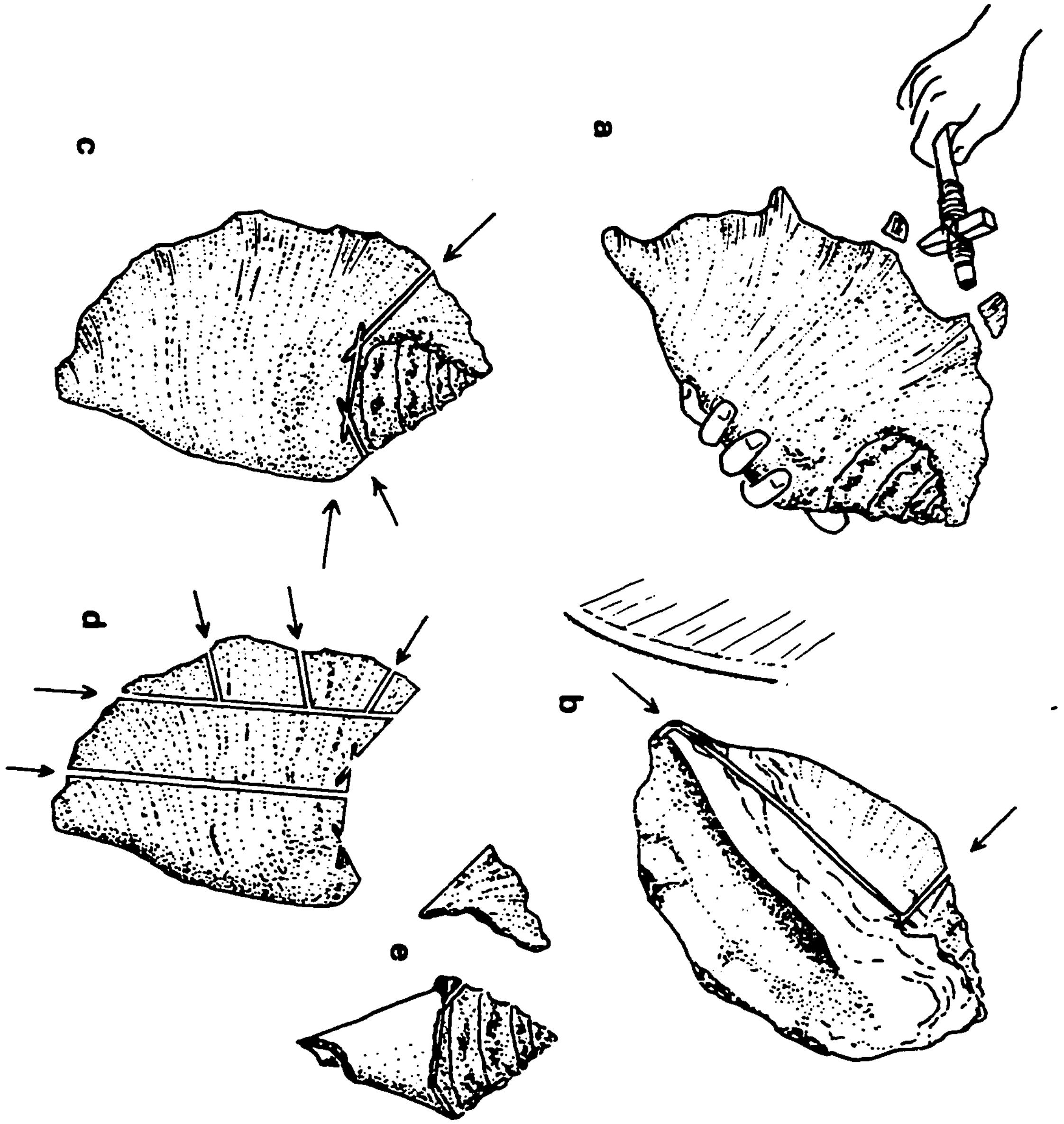


FIGURE 3-9. INLAY MANUFACTURE WITH Fasciolaria trapezium.

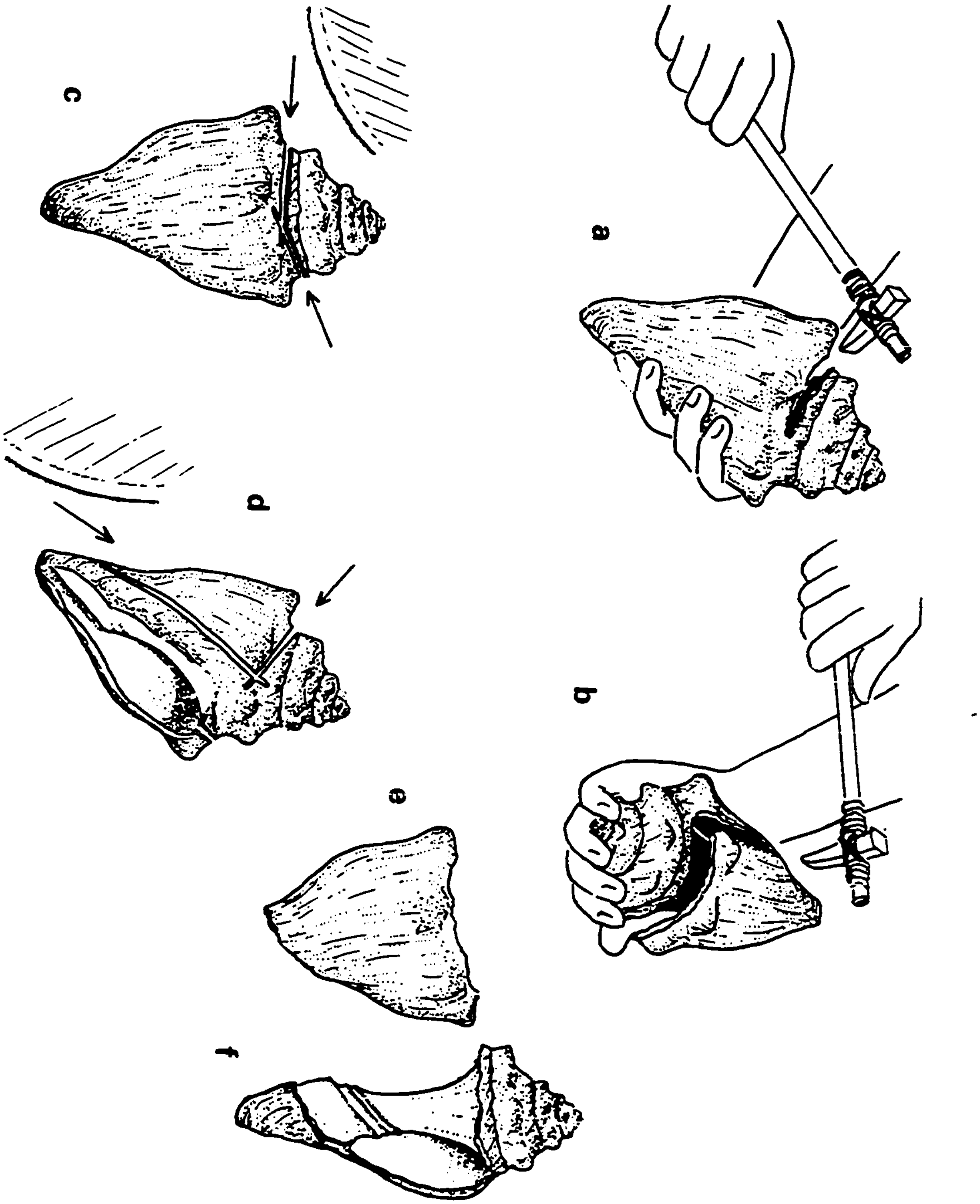


FIGURE 3-10. MOHENJO DARO; SHELL BANGLES.

1. Incised and engraved with script, *Turbinella pyrum* (MD/83/150)
2. Incised and repaired, *T. pyrum* (HRE/83/554)
3. Incised, interior not finished, *T. pyrum* (Channel/82/107)
4. Incised, heavily worn, *T. pyrum* (MD/83/170)
5. Incised, heavily worn, *Chicoreus ramosus* (MN/83/416)
6. Incised, multiple slashes, *T. pyrum* (MN/83/403)
7. Heavily worn, *T. pyrum* (MD/83/148)
8. Incised, multiple slashes, *T. pyrum* (DK/83/439)
9. Wide, heavily worn, *T. pyrum* (E/83/104)
10. Wide, heavily worn, *T. pyrum* (E/83/105)
11. Non-Harappan, ? Buddhist Period, *T. pyrum* (MD/83/155)
12. Repaired , heavily worn, *T. pyrum* (HRE/83/298)

FIGURE 3-10. MOHENJO DARO; SHELL BANGLES.

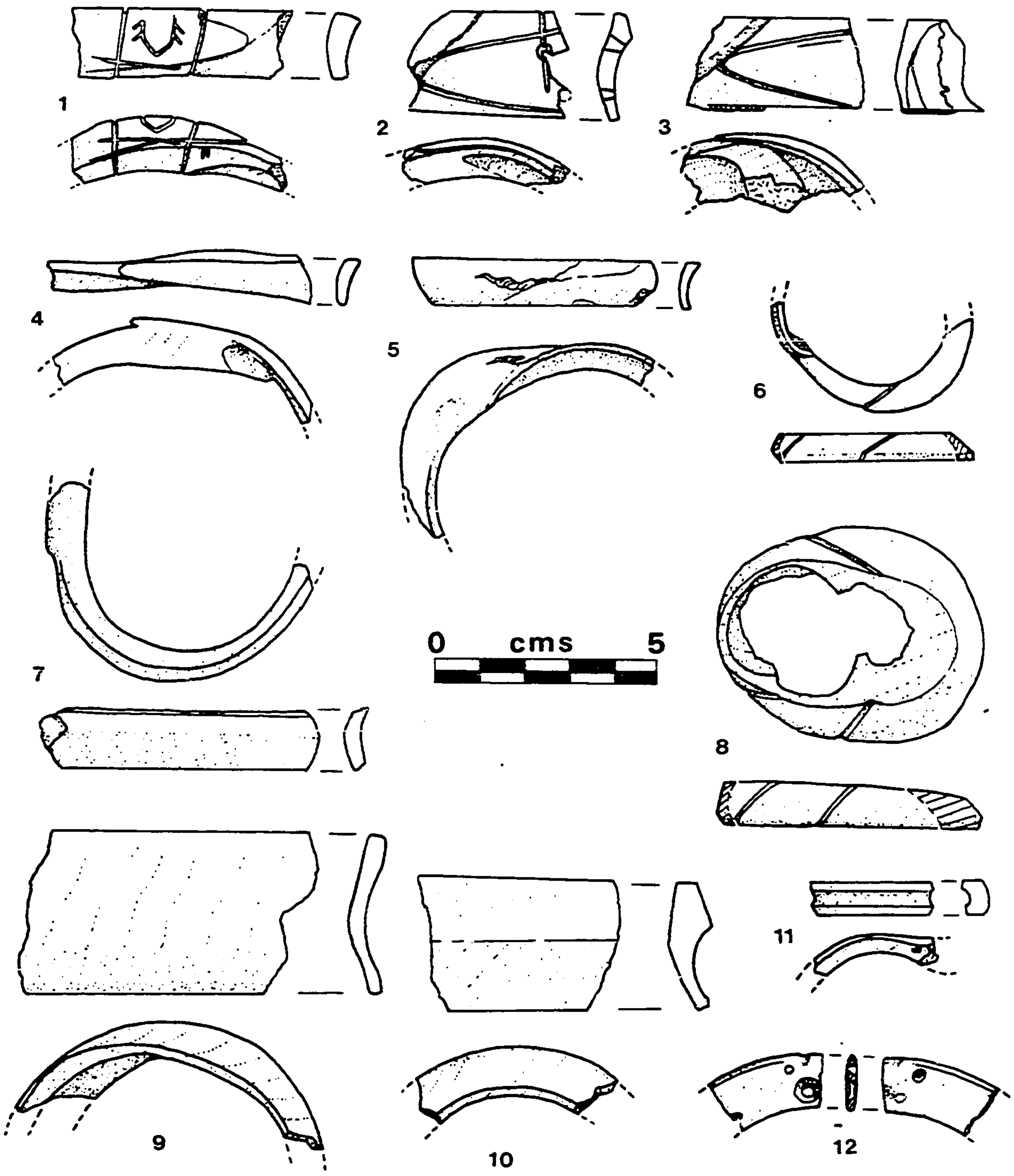


FIGURE 3-11. MOHENJO DARO; SHELL ARTIFACTS.

1. Reworked bangle fragment, _T. pyrum_ (MN/83/475)
2. Reworked bangle fragment, _T. pyrum_ (HRE/83/432)
3. Reworked bangle fragment, _T. pyrum_ (E/83/122)
4. Reworked bangle fragment, _T. pyrum_ (MD/83/159)
5. Reworked bangle fragment/ bead blank, _T. pyrum_ (MD/83/539)
6. Reworked bangle fragment/ bead blank, _T. pyrum_ (MD/83/540)
7. Bead blank, species ? (MN/83/549)
8. Bead blank, species ? (HRS/83/544)
9. Unfinished bead, species ? (HRS/83/547)
10. Finished bead , species ? (DKG/83/524)
11. Drilled Inlay , species ? (MD/83/487)
12. Partly drilled fragment, species ? (LN/83/418)
13. Bead, species ? (MN/83/419)
14. Bead, species ? (DKG/83/493)
15. Bead, species ? (HRE/83/349)
16. Bead, species ? (NE,Mound/83/490)
17. Pendant, _Cypraea turdus_. (DK/83/525)
18. Pendant, _Nerita_, sp. (HRE/83/413)
19. Inlay blank, species ? (HRE/83/264)
20. Finished inlay, species ? (MN/83/71)
21. Inlay waster, species ? (L/83/46)
22. Fretted inlay, species ? (MN/83/49)
23. Fretted inlay, species ? (HRN/83/50)
24. Triangular inlay, species ? (MN/83/531)
25. Triangular inlay, species ? (MN/83/417)
26. Unfinished ground disc, species ? (MN/83/121)

27. Tubular drill waster, species ?
(DK/83/545)
28. Inlay, concentric incised circles, species ?
(DK/83/53)
29. Inlay, concentric incised circles, species ?
(M/83/535)
30. Inlay, with incised design, species ?
(DK/83/220)
31. Inlay/ disc, species ?
(MD/83/201)
32. Unfinished inlay, species ?
(SD/83/330)
33. Finished inlay, species ?
(VS/83/358)
34. Triangular inlay, species ?
(DK/83/304)
35. Triangular inlay, species ?
(MN/83/315)
36. Sawn body whorl. _T_. _pyrum_
(L/83/445)
37. Sawn apex fragment, _T_. _pyrum_
(MN/83/190)
38. Sawn and ground apex fragment, _T_. _pyrum_
(DK/83/523)

FIGURE 3-11. MOHENJO DARO; SHELL ARTIFACTS.

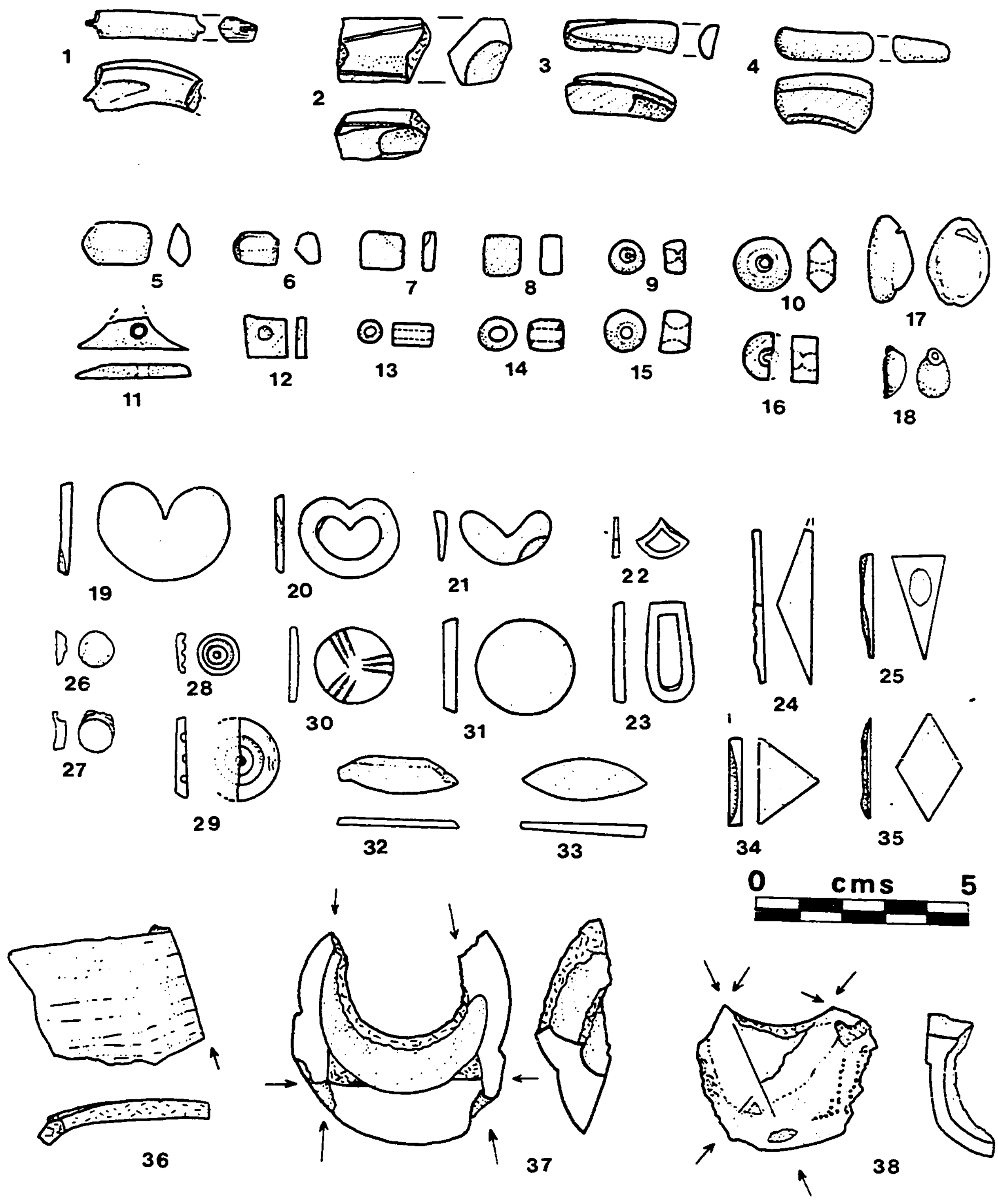


FIGURE 3-12. MOHENJO DARO; SHELL ARTIFACTS.

1. Sawn columella, *T. pyrum* (MD/83/196)
2. Sawn and ground columella, *T. pyrum* (HRE/83/412)
3. Unfinished "wavey ring", *T. pyrum* (DK/83/415)
4. Unfinished "wavey ring", *T. pyrum* (DK/83/546)
5. Finished "wavey ring", *T. pyrum* (HRS/83/110)
6. Finished ring, *T. pyrum* (MD/83/203)
7. Finished "wavey ring", *T. pyrum* (MD/83/191)
8. Finished "wavey ring", *T. pyrum* (MN/83/209)
9. Finished "wavey ring", *T. pyrum* (DK/83/52)
10. Finished "wavey ring", *T. pyrum* (HRE/83/252)
11. Sawn plank, *Lambis truncata sebae* (MD/83/198)
12. Sawn and ground columella, *T. pyrum* (SD/83/324)
13. Unfinished object, *T. pyrum* (DK/83/542)
14. Broken figurine,? Tortoise, species ? (HRS/83/526)
15. Carved lid, *Lambis truncata sebae* (MN/83/414)
16. "Cap", 1/2 type, *T. pyrum* (MN/83/72)

FIGURE 3-12. MOHENJO DARO; SHELL ARTIFACTS.

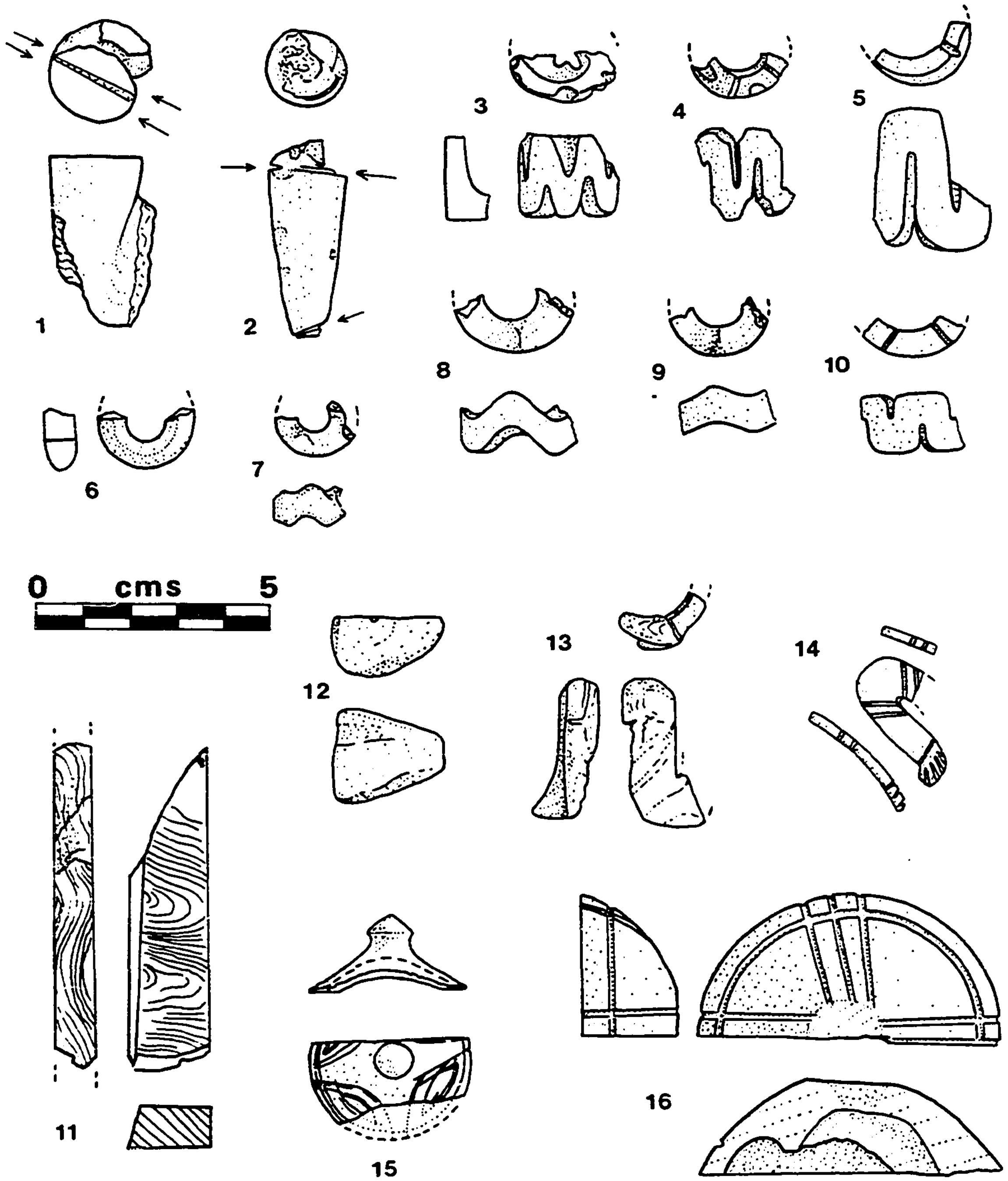


FIGURE 3-13. MOHENJO DARO; SHELL ARTIFACTS.

1. Ladle,heavily worn, <u>Chicoreus ramosus</u> (E/83/99)
2. Inlay rough-out, sawn and chipped, <u>T. pyrum</u> (E/83/97)
3. Drill back made from inlay waster, <u>Lambis truncata sebae</u>, (DK/83/45)

FIGURE 3-13. MOHENJO DARO; SHELL ARTIFACTS.

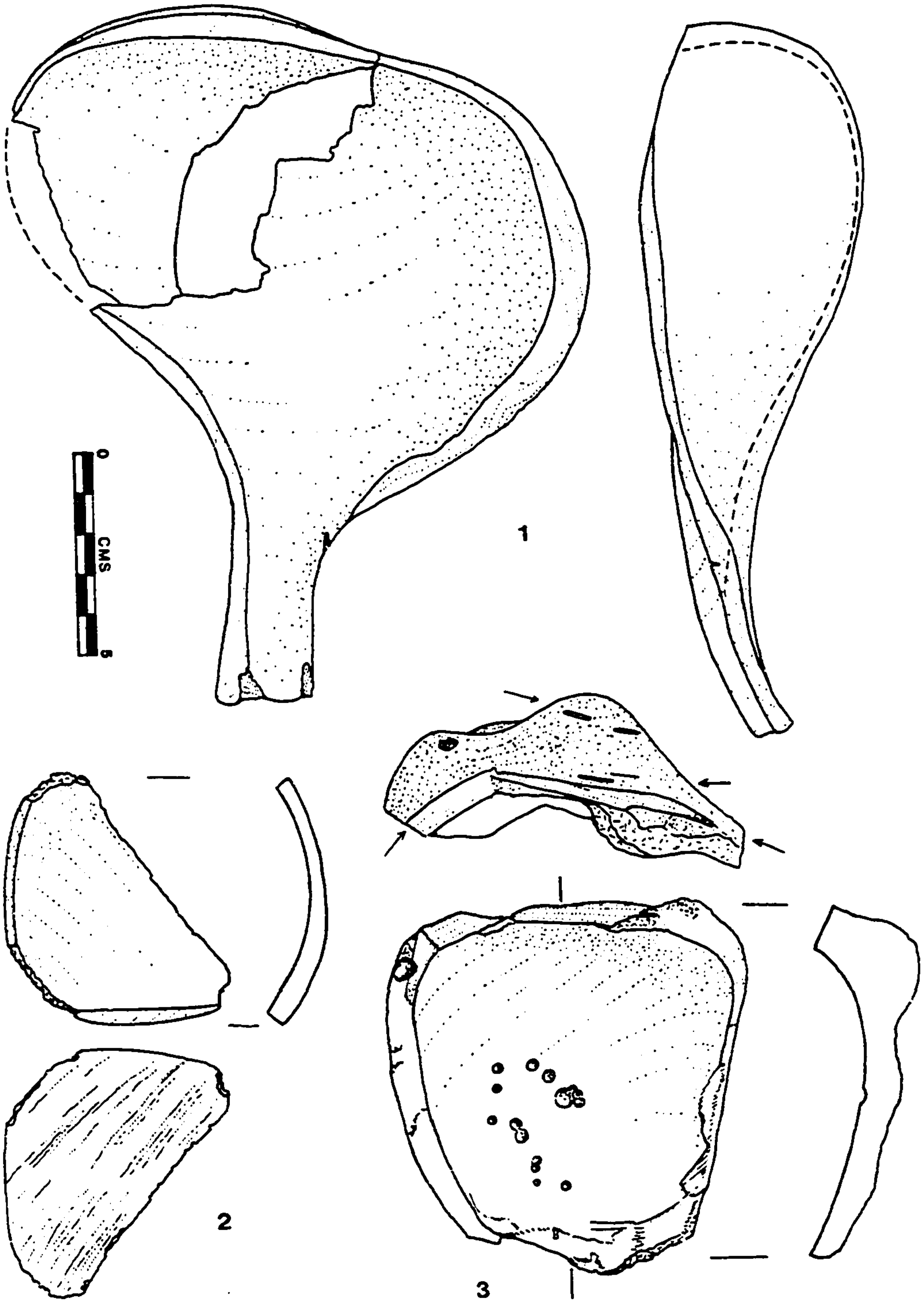


FIGURE 3-14. MOHENJO DARO; SHELL ARTIFACTS.

1. Composite Bull Figurine, hump, _Lambis truncata sebae_ (L 781)
2. Composite Bull Figurine, head, _Lambis truncata sebae_ (DK 5923, MM913)
3. Bird figurine, flat inlay?, species ? (#?, MM 937)
4. Snake or Tortoise Head, _Turbinella pyrum_ (SD 3307)
5. Frog figurine, _Lambis truncata sebae_ (DK 95)
6. Inlay, zig-zag design, species ? (HR 4625, MM 912)
7. Inlay, stepped cross, species ? (DK 8317 MM 905)
8. Inlay, fretted design, species ? (HR 4517, MM 907)
9. Inlay, rosette, species ? (#?,MM906)
10. Natural shell pendant, _Cypraea arabica grayana_ 1:1 sketch (VS 371)

FIGURE 3-14. MOHENJO DARO; SHELL ARTIFACTS.

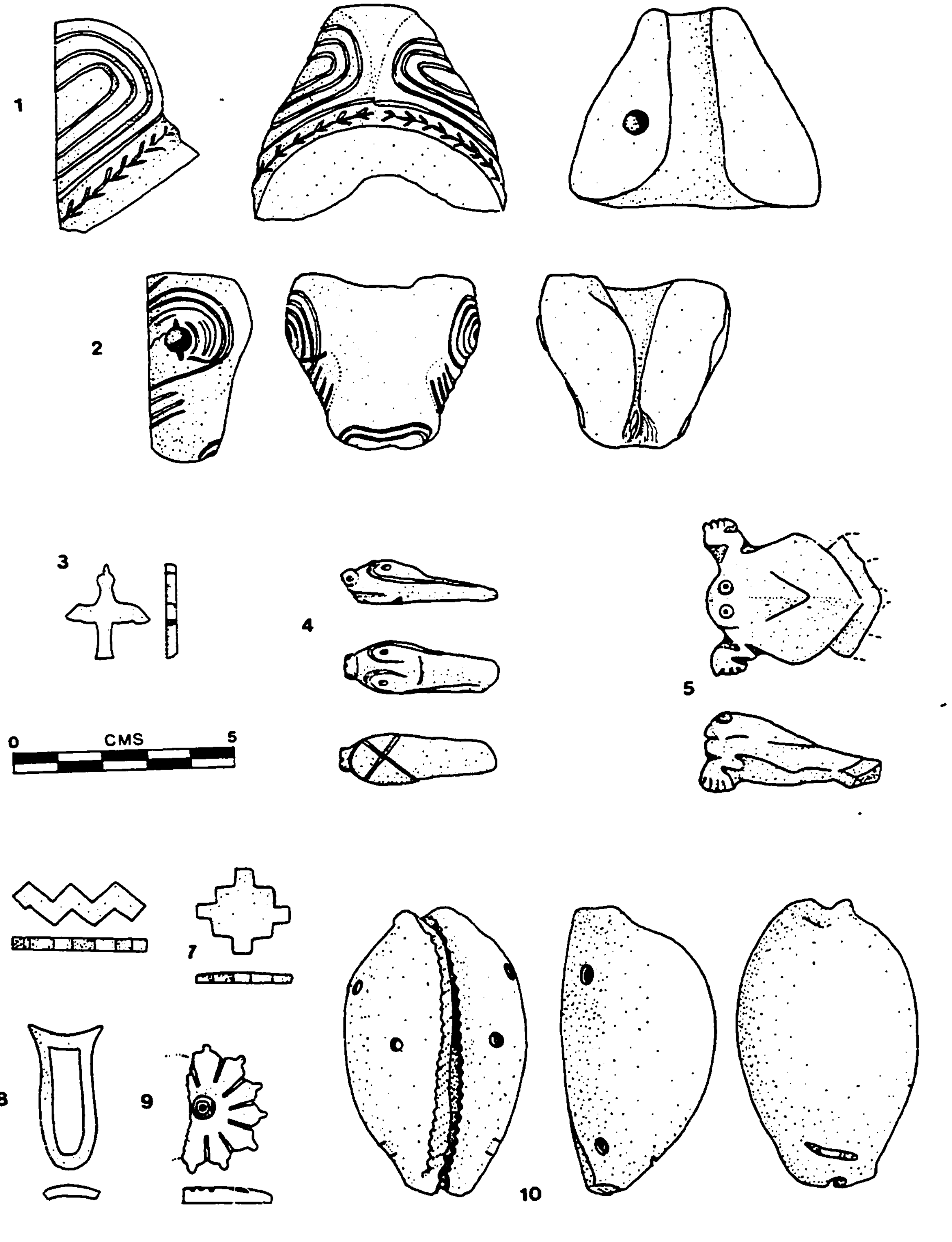


FIGURE 3-15. MOHENJO DARO; SHELL ARTIFACTS.

1. Special object, half ring, *Turbinella pyrum* (HR 3898)
2. Special object, half ring, *Turbinella pyrum* (SD 566)
3. Special object, half ring, unfinished *Turbinella pyrum*, (E 2208)
4. "Libation vessel", *Turbinella pyrum* (HR 3517)
5. "Libation vessel", *Turbinella pyrum* (DK 8538)
6. "Libation vessel", *Turbinella pyrum* (HR 5726)

FIGURE 3-15. MOHENJO DARO; SHELL ARTIFACTS.

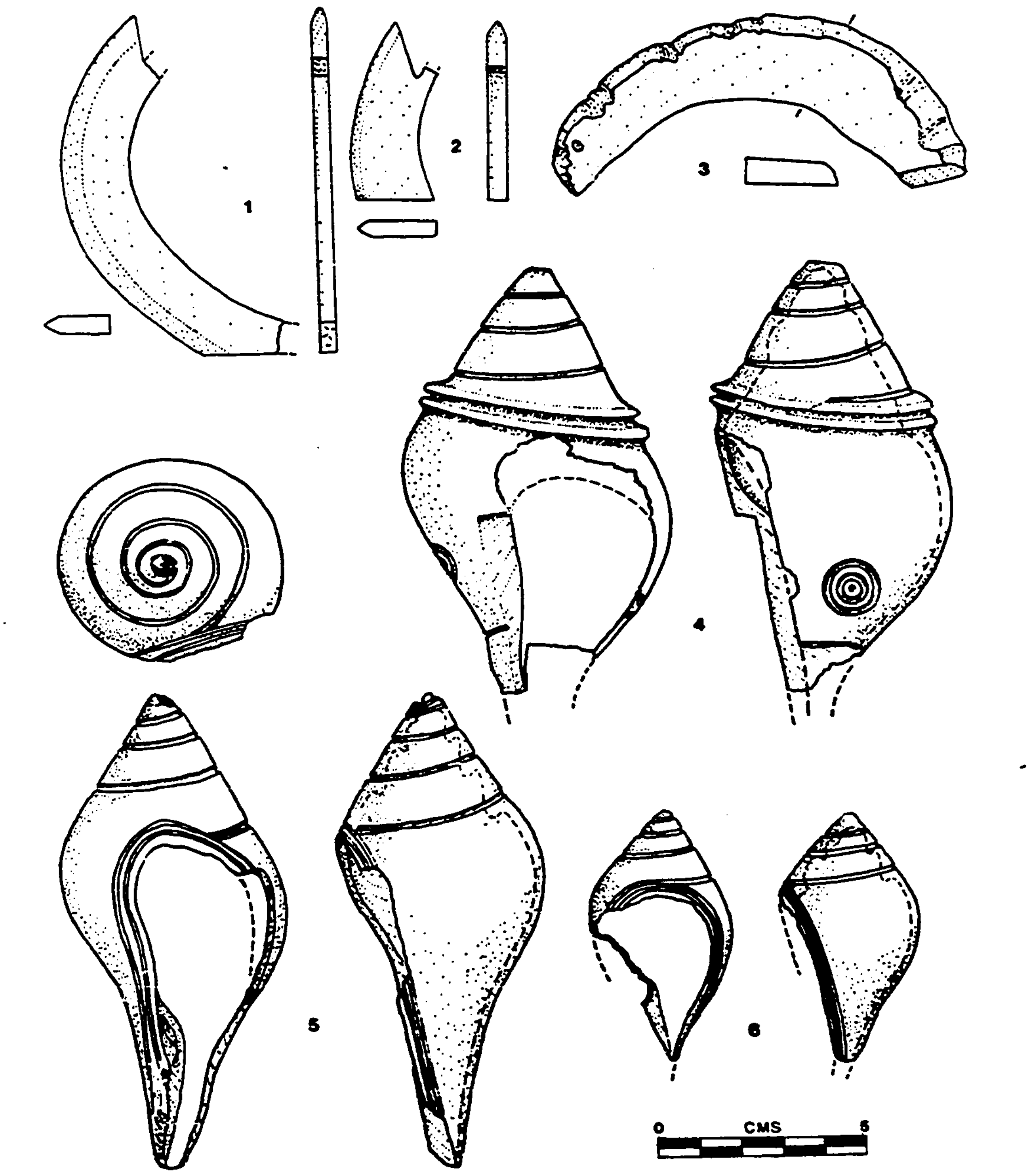


FIGURE 3-16. MOHENJO DARO; SHELL DISTRIBUTION, SURFACE SURVEY.

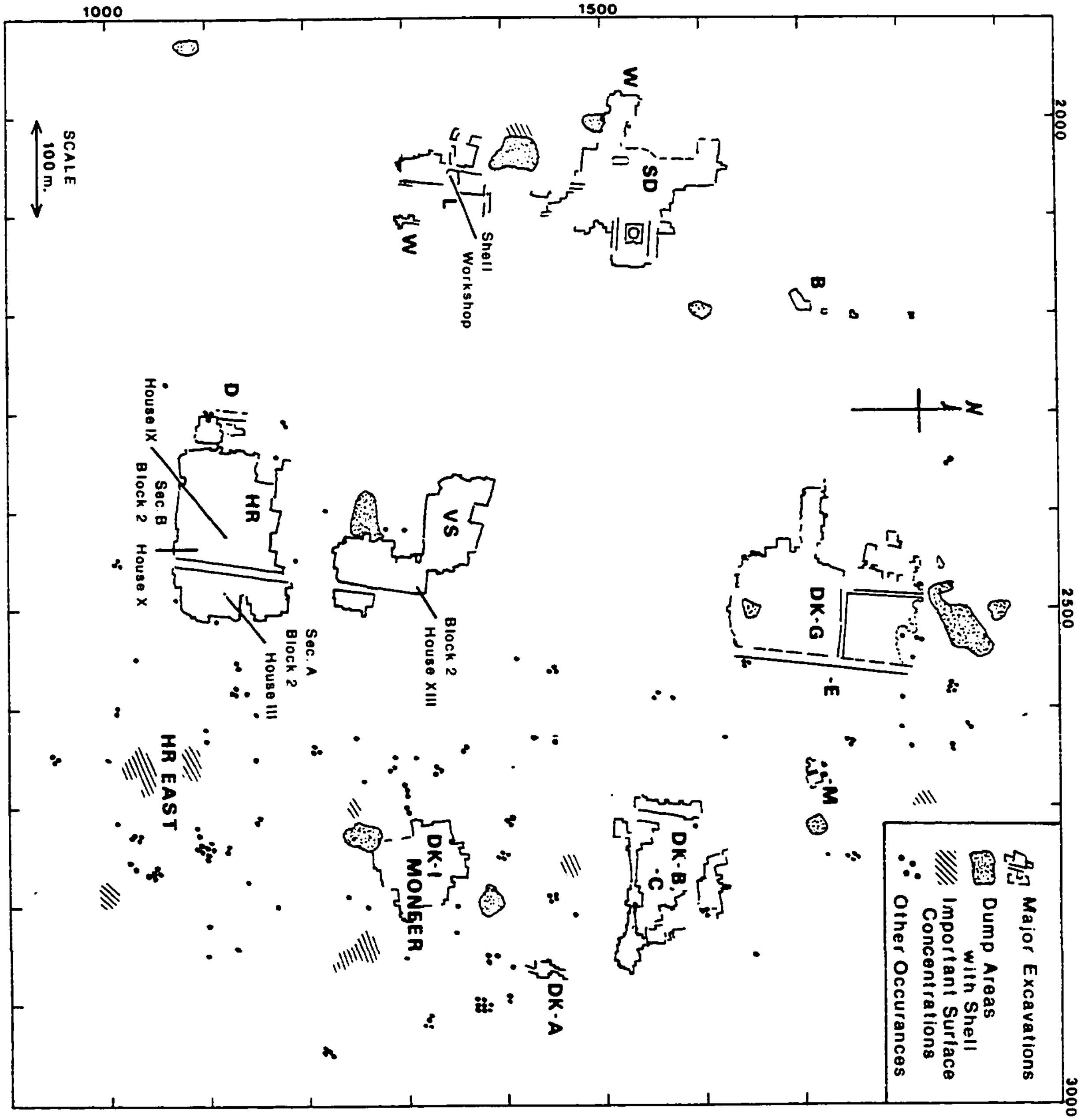


FIGURE 3-17. HARAPPA; SHELL BANGLES.

1. Bangle, incised, *Turbinella pyrum* (#?, HM 13086)
2. Bangle, incised, *Turbinella pyrum* (#?, HM 13092)
3. Bangle, incised, *Turbinella pyrum* (H 813(t), HM 1360)
4. Bangle, incised, *Turbinella pyrum* (#?, HM 13092)
5. Bangle, incised, *Turbinella pyrum* (#?, HM 13059)
6. Bangle, incised, *Chicoreus ramosus* (#?, PWM 1899)
7. Bangle, incised, *Chicoreus ramosus* (#?, PWM 1900)

FIGURE 3-17. HARAPPA; SHELL BANGLES.

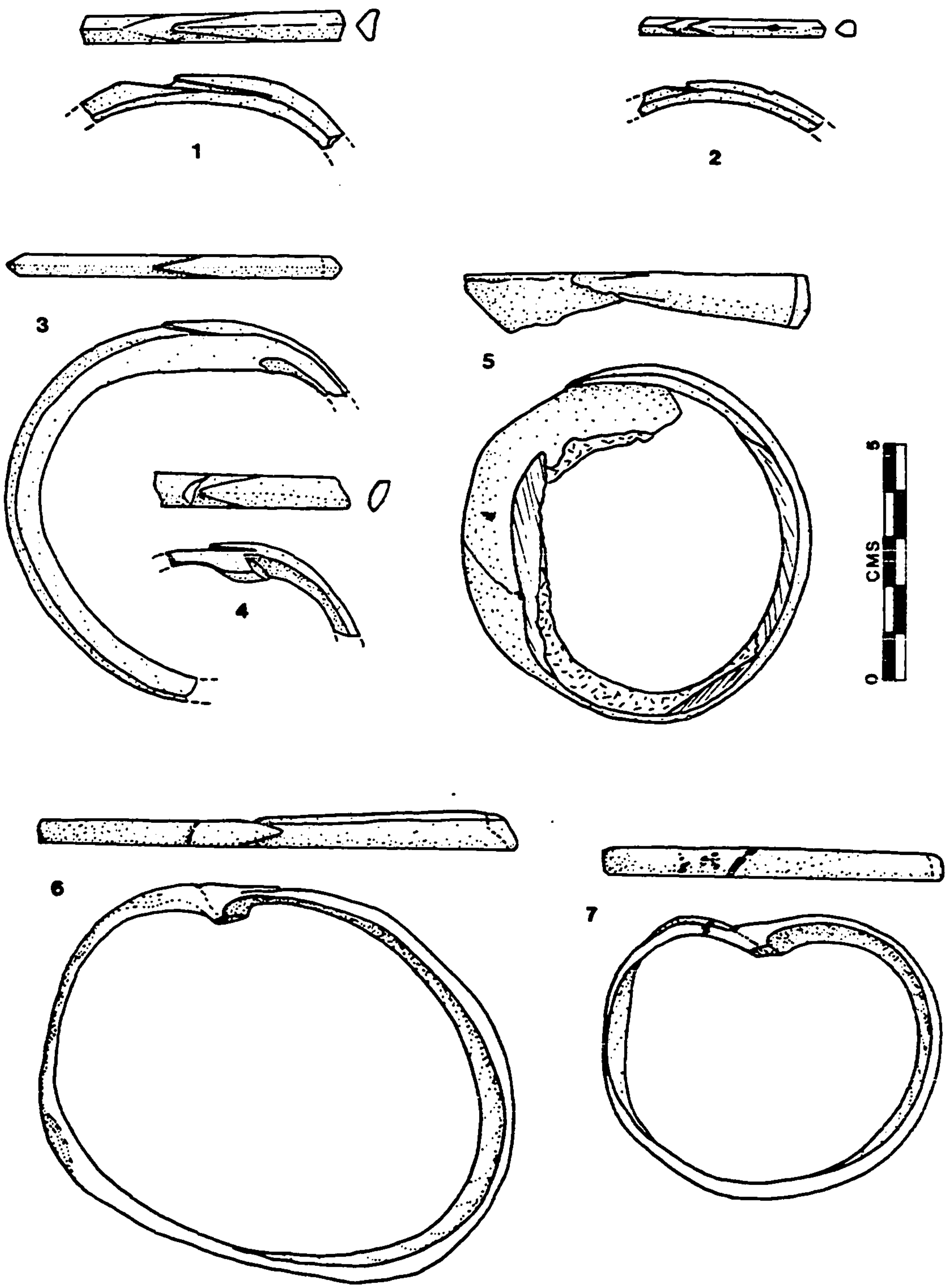


FIGURE 3-18. HARAPPA; SHELL BANGLES AND OTHER ARTIFACTS.

1. Bangle, wide,incised, _Turbinella pyrum_ (B 1578, HM 13828)
2. Bangle, wide, _Turbinella pyrum_ (*?, Harappa Reserve Collection)
3. Bangle, wide,unfinished, _Turbinella pyrum_ (B 1752, HM 13829)
4. Bangle, double wide groove, _Turbinella pyrum_ (*?, HM 13097)
5. Bangle, single wide groove, _Turbinella pyrum_ (*?, HM 13074)
6. Bangle, single deep groove, incised and drilled, _Turbinella pyrum_ (*?, HM 13081)
7. Manufacturing waste, sawn outer lip, _Lambis truncata sebae_ (*?, HM 13058)

FIGURE 3-18. HARAPPA; SHELL BANGLES AND OTHER ARTIFACTS.

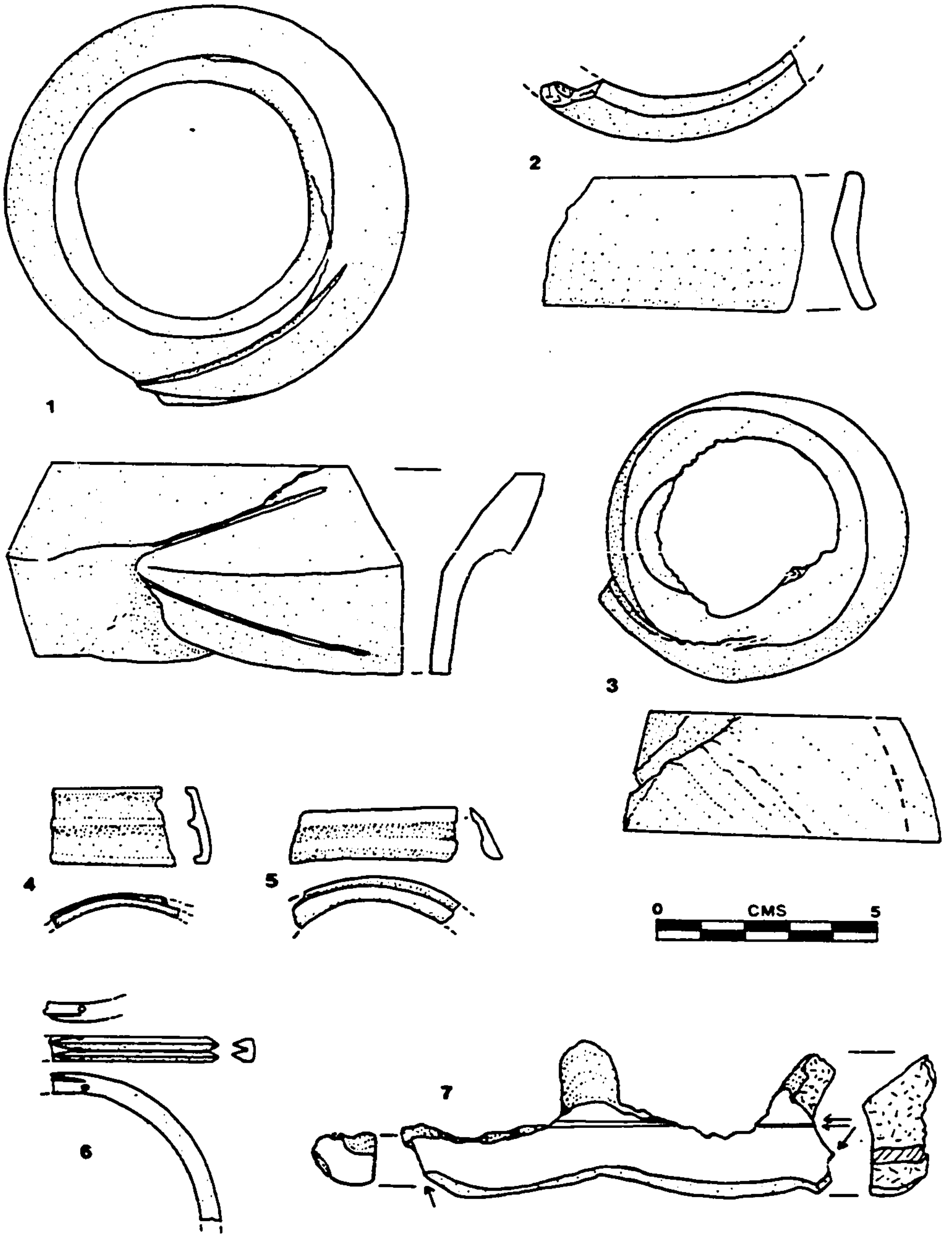


FIGURE 3-19. HARAPPA; SHELL ARTIFACTS.

1. Inlay manufacturing waste, sawn and chipped apex, (134, HM 13028)
2. Inlay manufacturing waste, sawn and chipped apex, (#?, Harappa Reserve Collection)
3. Inlay manufacturing waste, sawn and chipped apex, *Turbinella pyrum* (#?, HM 13046)
4. Perforated ornament/ pendant?, *Turbinella pyrum* (10884, HM 13020)

FIGURE 3-19. HARAPPA; SHELL ARTIFACTS.

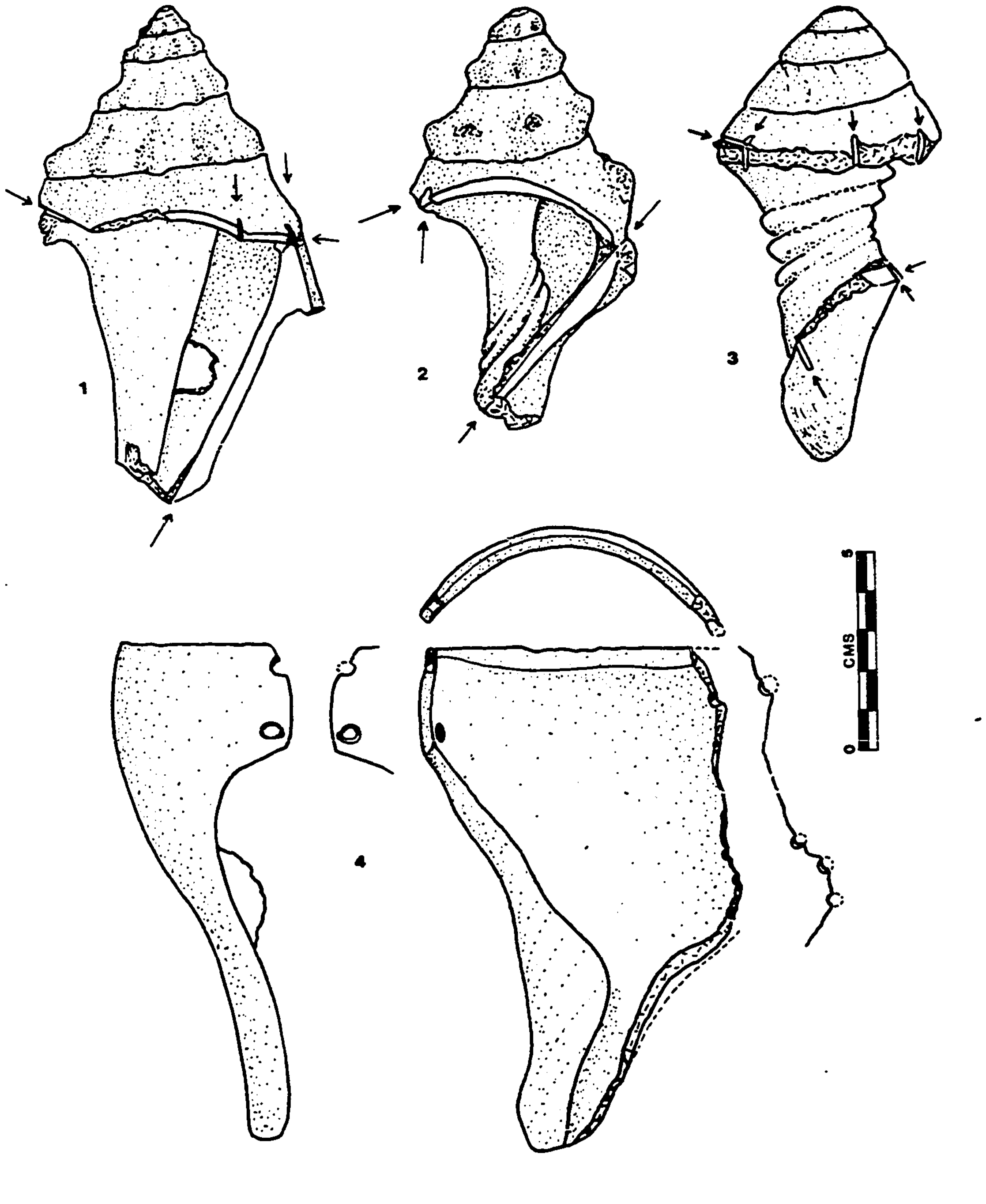


FIGURE 3-20. HARAPPA; SHELL ARTIFACTS.

1. Inlay, half ellipse, species?
   (#?, HM 13108)
2. Inlay, petal shape, species?
   (#?, HM 13119)
3. Inlay, petal shape, species?
   (#?, HM 13121)
4. Inlay, square, faceted, species?
   (#?, HM 13118)
5. Sawn manufacturing waste, species?
   (B 1360, HM 13069
6. Inlay waster, tubular drilled, Chicorues ramosus
   (E 2342, Lahore Museum, possibly from Mohenjo Daro)
7. Lid/Stopper ?, Turbinella pyrum
   (#?, Harappa Reserve Collection)
8. Pendant, species?
   (R 3884)
9. Unfinished figurine, bird?, Turbinella pyrum
   (#?, HM 1300)
10. Composite figurine, incised with tubular drill, Turbinella pyrum, (#?, HM 13008)
11. Reworked bangle fragment, Turbinella pyrum?
    (#?, HM 13068)
12. Reworked bangle fragment, Turbinella pyrum?
    (#?, HM 13014)
13. Trumpet, Turbinella pyrum
    (R 2332, Lahore Museum)

FIGURE 3-20. HARAPPA; SHELL ARTIFACTS.

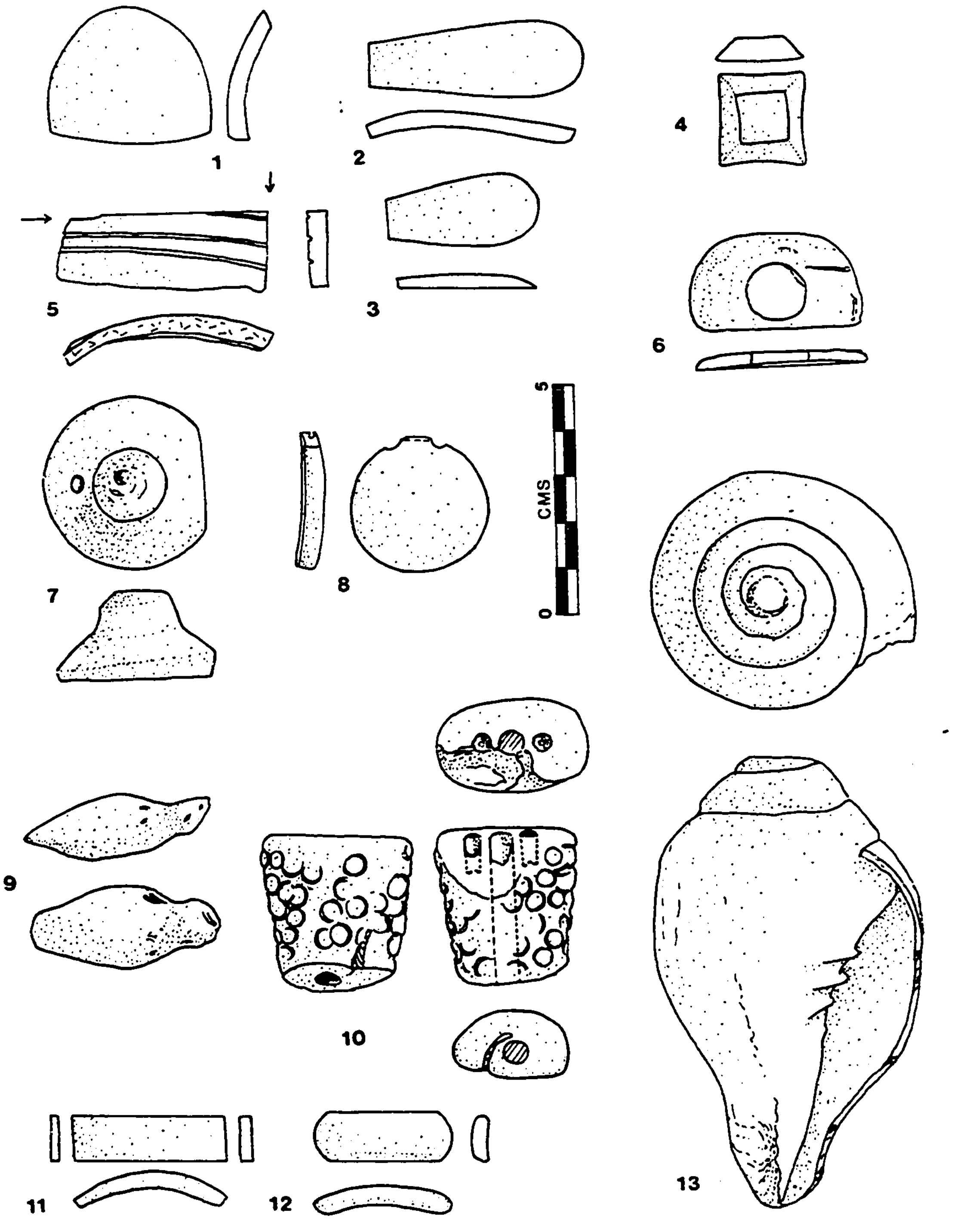


FIGURE 3-21. BALAKOT; BANGLE MANUFACTURE, *Tivela damaoides*

1. Chipping the ventral edge.
2. Grinding the rough ventral edge.
3. Primary grinding of the convex surface.
4. Perforating the center of the ground surface.
5. Grinding the umbo and chipping it off.
6. Grinding the ventral face of the bangle. (not illustrated)
7. Chipping and grinding the center hole.
8. Grinding away the natural shell surface.
9. Smoothing the interior edge.
10. Incising the chevron design, variations a) and b).

FIGURE 3-21. BALAKOT; SHELL BANGLE MANUFACTURE, Tivela damaoides

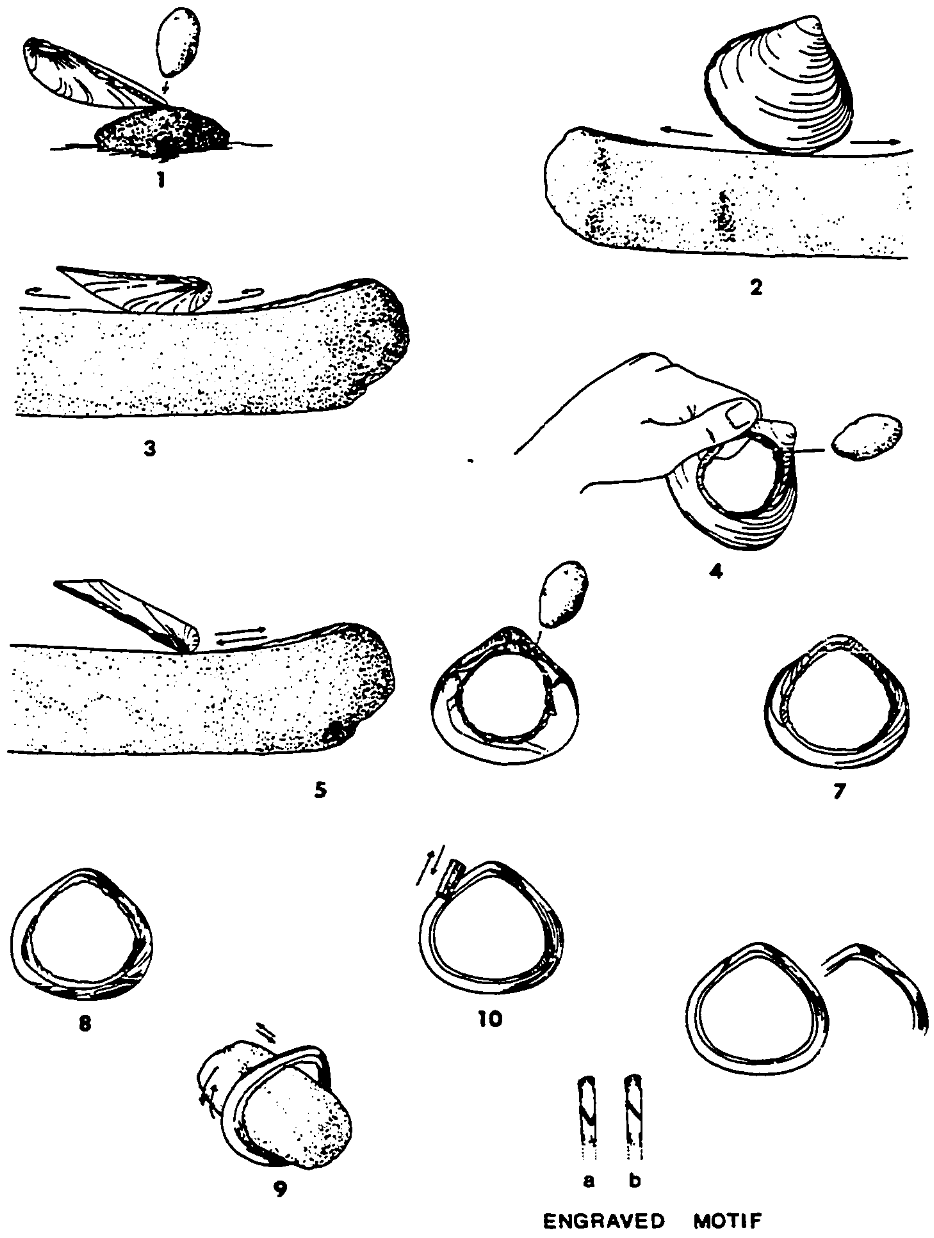


FIGURE 3-22. BALAKOT; SHELL BANGLES.

1. Incised Bangle, *Turbinella pyrum* (3BLK/Lot 345)
2. Incised Bangle, *Turbinella pyrum* (2BLK/Lot 187)
3. Bangle, unfinished, *Turbinella pyrum* (2BLK/Lot 385)
4. Incised bangle, *Tivela damaoides* (2BLK/Lot 405)
5. Incised bangle, *Tivela damaoides* (2BLK/Lot 306)
6. Incised bangle, *Tivela damaoides* (2BLK/Lot 369)
7. Incised bangle, *Tivela damaoides* (2BLK/Lot 36)
8. Incised bangle, very worn, *Tivela damaoides* (2BLK/Lot 128)
9. Grooved bangle, *Turbinella pyrum* (2BLK, Lot 161)

FIGURE 3-22. BALAKOT; SHELL BANGLES.

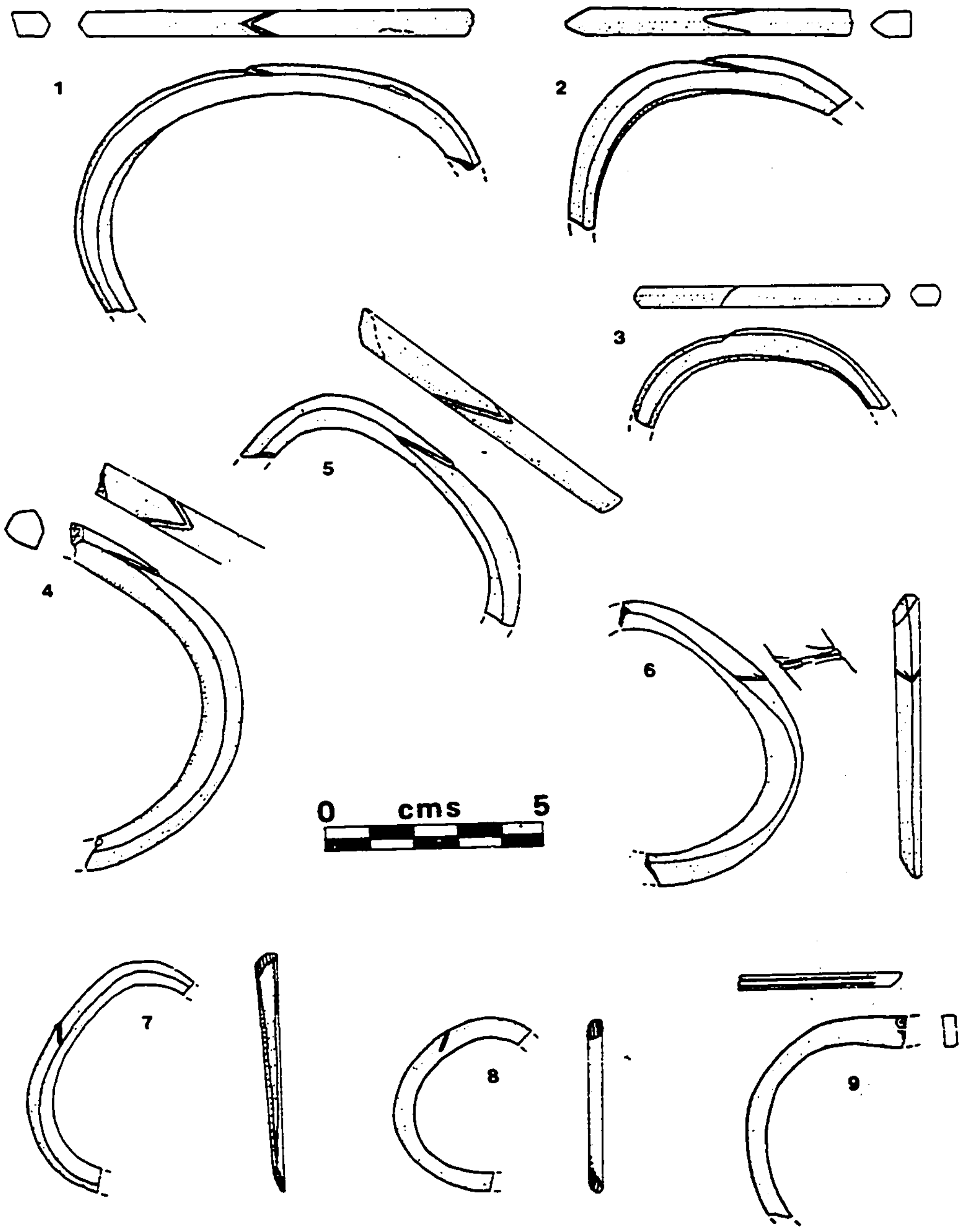


FIGURE 3-23. BALAKOT; SHELL ARTIFACTS.

1. Bangle fragment, extremely thin, _Turbinella pyrum_ (4BLK/Lot 96)
2. Bangle fragment, extremely thin, _Turbinella pyrum_ (4BLK/Lot 96)
3. Bangle fragment, extremely thin, _Turbinella pyrum_ (4BLK/Lot 96)
4. Pendant, _Conus_ cf. _betulinus_ (4BLK/Lot 110)
5. Primary stage of bangle manufacture, _T. pyrum_ (4BLK/ Lot 237)

FIGURE 3-23. BALAKOT; SHELL ARTIFACTS.

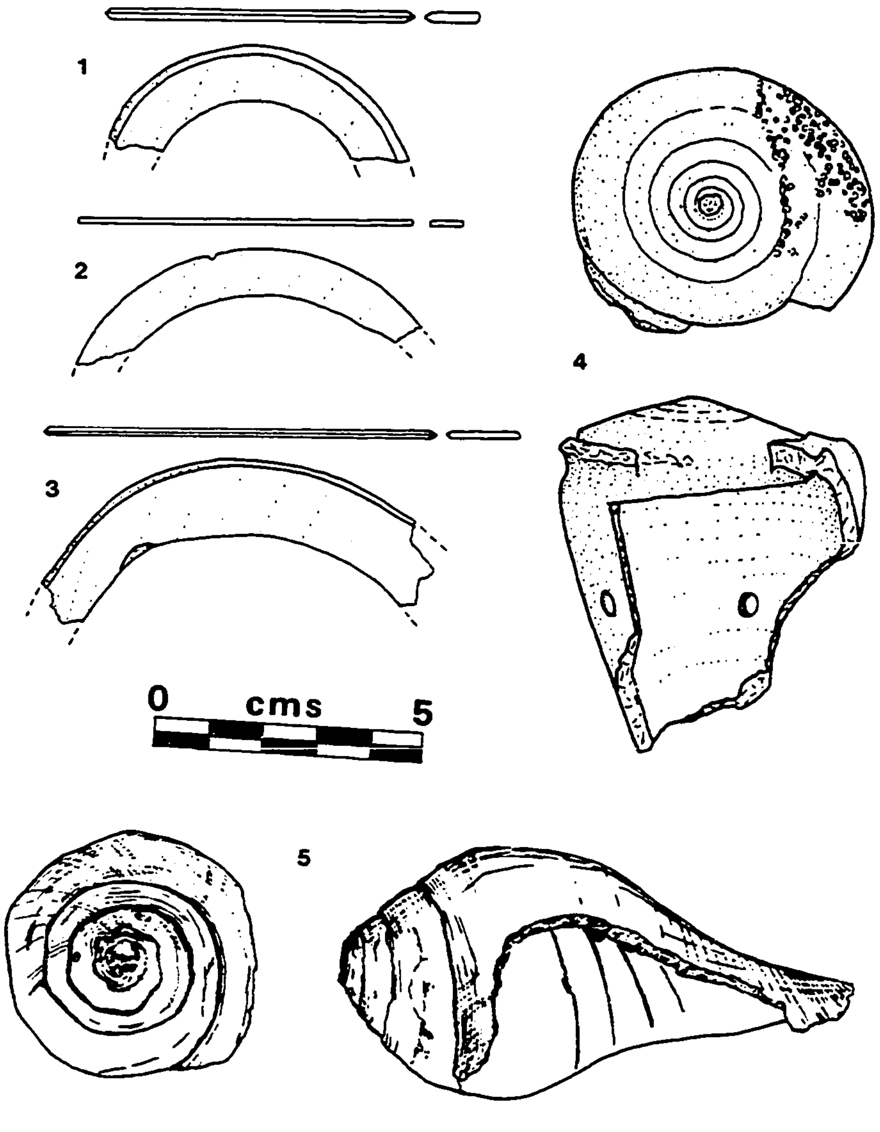


FIGURE 3-24. BALAKOT; BANGLE MANUFACTURING WASTE.

1. Sawn umbo, *Tivela damaoides* (4BLK/Lot 271)
2. Sawn umbo, *Tivela damaoides* (4BLK/Lot 278)
3. Sawn apex, *Turbinella pyrum* (4BLK/E 28, surface)
4. Sawn bangle waster, *Turbinella pyrum* (4BLK/E 28, surface)
5. Sawn anterior, *Turbinella pyrum* (4BLK/E 28, surface)
6. Sawn anterior, *Turbinella pyrum* (4BLK/E 28, surface)

FIGURE 3-24. BALAKOT; BANGLE MANUFACTURING WASTE.

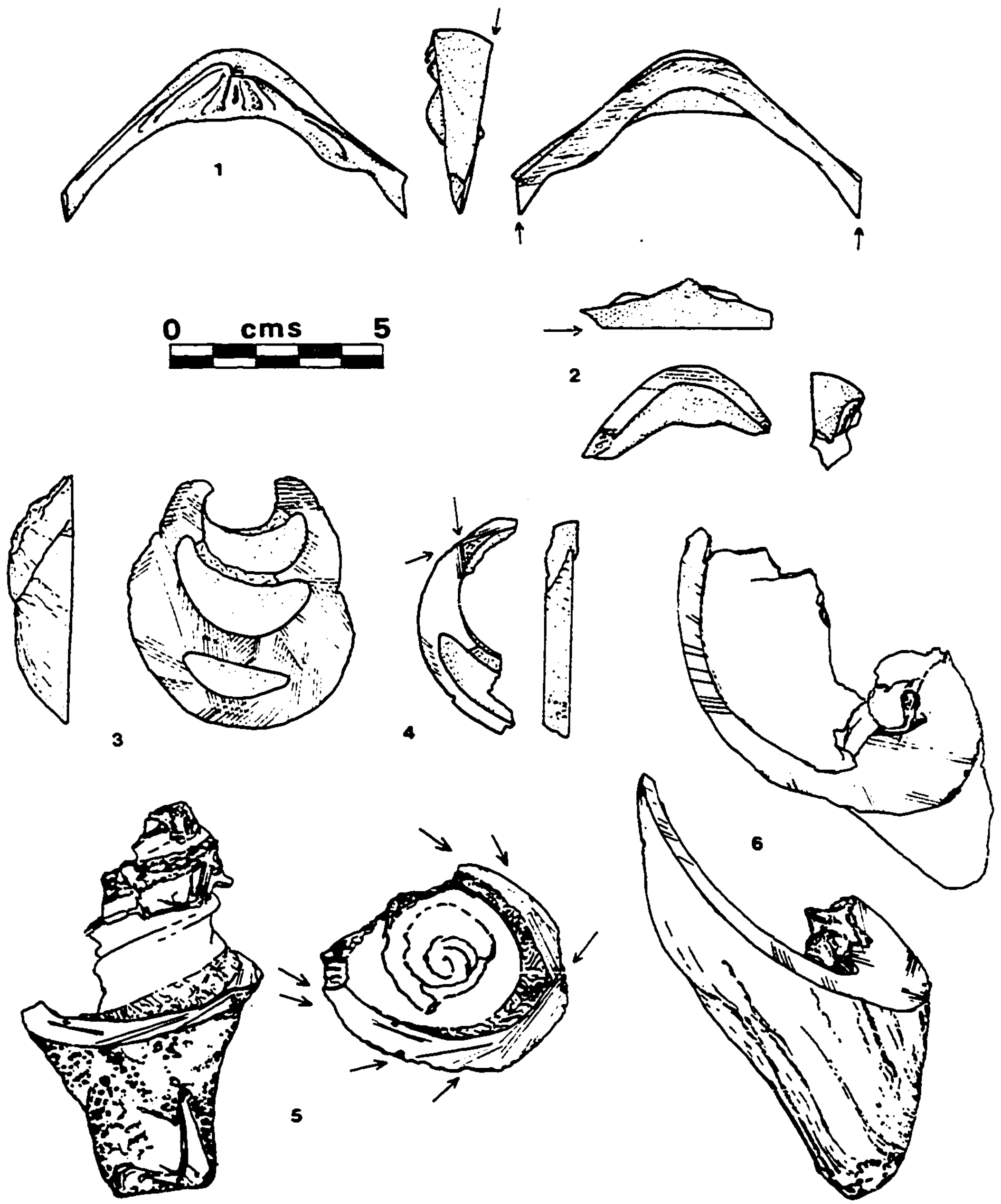


FIGURE 3-25. LOTHAL; SHELL ARTIFACTS.

1. Incised bangle, Turbinella pyrum (SRG /15238)
2. Bangle fragment, Tivela damaoides (SRG /AXIII-AXXV (4), Phase II or III)
3. Grooved bangle, Turbinella pyrum (SRG2/4732, Phase II or III)
4. Perforated disc, Turbinella pyrum (SRG /15126)
5. Perforated disc, Turbinella pyrum (SRG /540G)
6. Perforated incised cylinder, T. pyrum (SRG /144D)
7. Perforated cylinder, T. pyrum (SRG2/10254)
8. Ribbed cylinder, T. pyrum (SRG /333D)
9. Unfinished cylinder, T. pyrum (SRG3/ 2958)
10. Button/stud, T. pyrum (SRG /17581)
11. Button/stud, T. pyrum (SRG /17580)
12. Incised shell cap, 1/3 circle variety Chicoreus ramosus (SRG 977)
13. Figurine fragment, tortoise ?, species? (SRG /11251)
14. Undetermined object, cart frame ?, T. pyrum (SRG /14633)
15. Button-seal, circular, Turbinella pyrum (SRG2/7105)
16. Button-seal, rectangular, Turbinella pyrum (SRG1/6780)
17. Button-seal, rectangular, Turbinella pyrum (SRG2/5559)
18. Square seal with unperforated boss, T. pyrum (SRG /8976)

FIGURE 3-25. LOTHAL; SHELL ARTIFACTS.

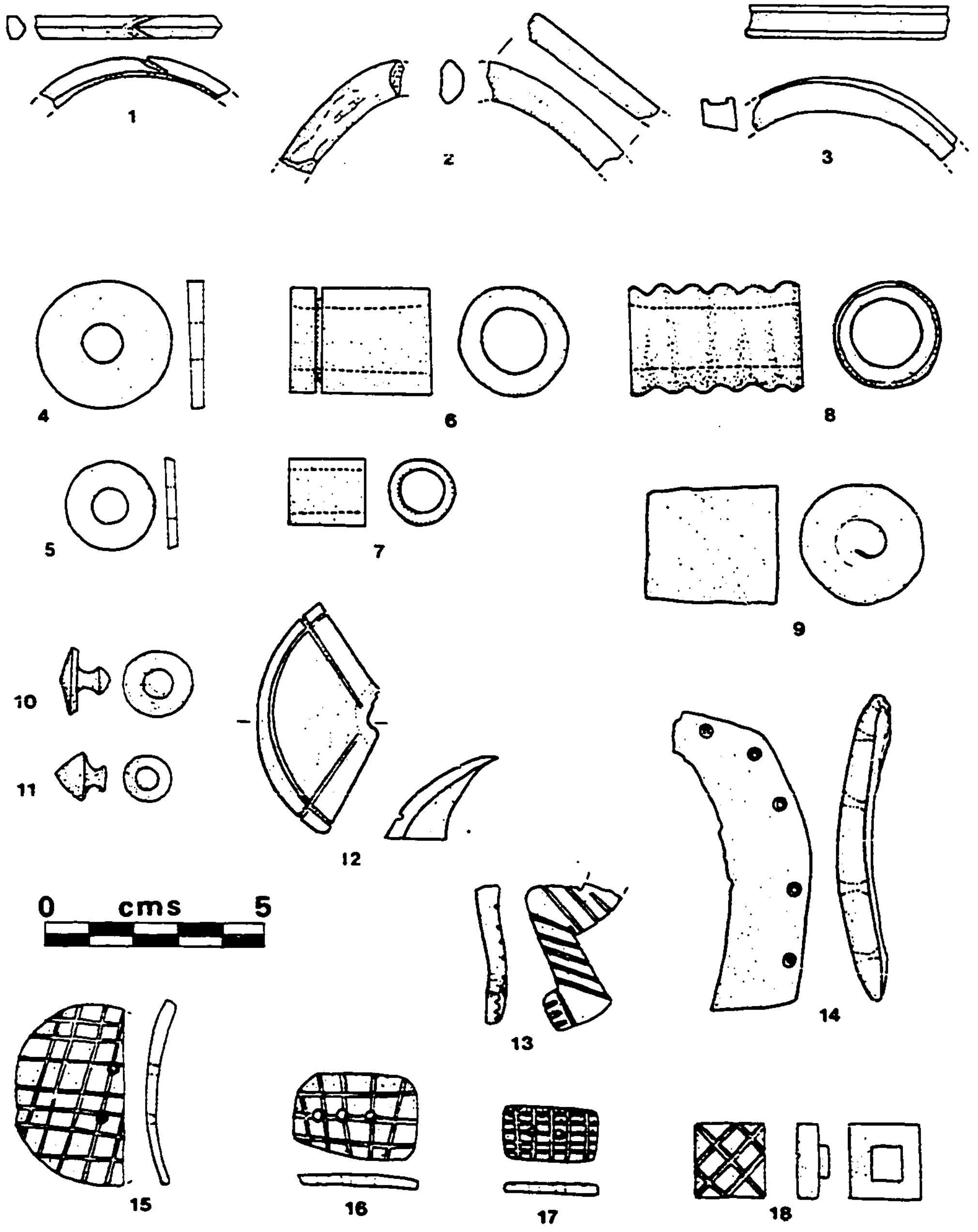


FIGURE 3-26. MAP. NAGESHWAR AND INDUS SITES.

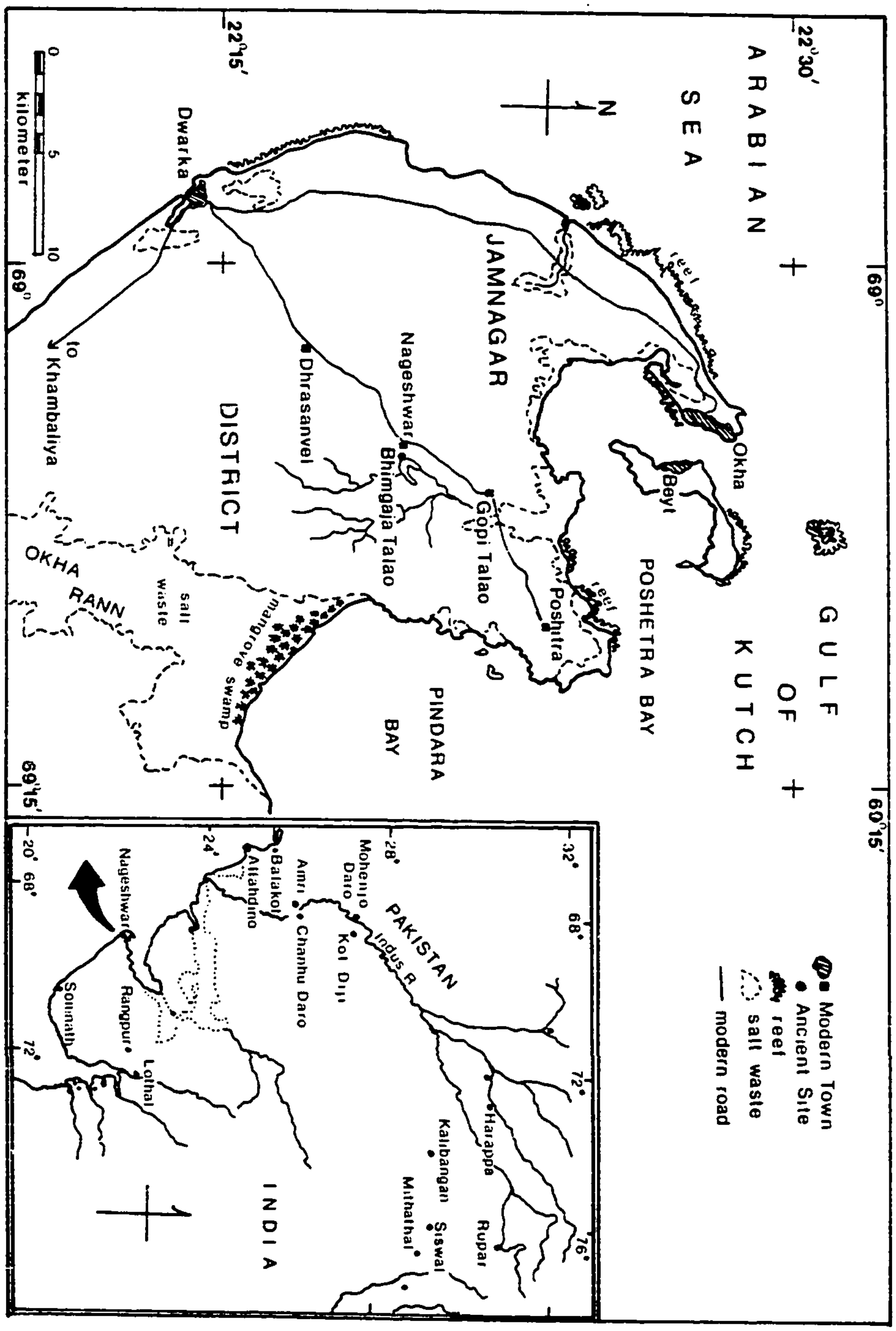


FIGURE 3-27. NAGESHWAR; SHELL ARTIFACTS.

1. Incised bangle, *Turbinella pyrum*
2. Incised bangle, *Turbinella pyrum*
3. Bangle fragment, *Turbinella pyrum*
4. Unfinished bangle, wide, *Chicoreus ramosus*
5. Unfinished bangle, thin, *T. pyrum*
6. Unfinished bangle, wide, *T. pyrum*
7. Unfinished bangle, thin, *T. pyrum*

FIGURE 3-27. NAGESHWAR; SHELL ARTIFACTS.

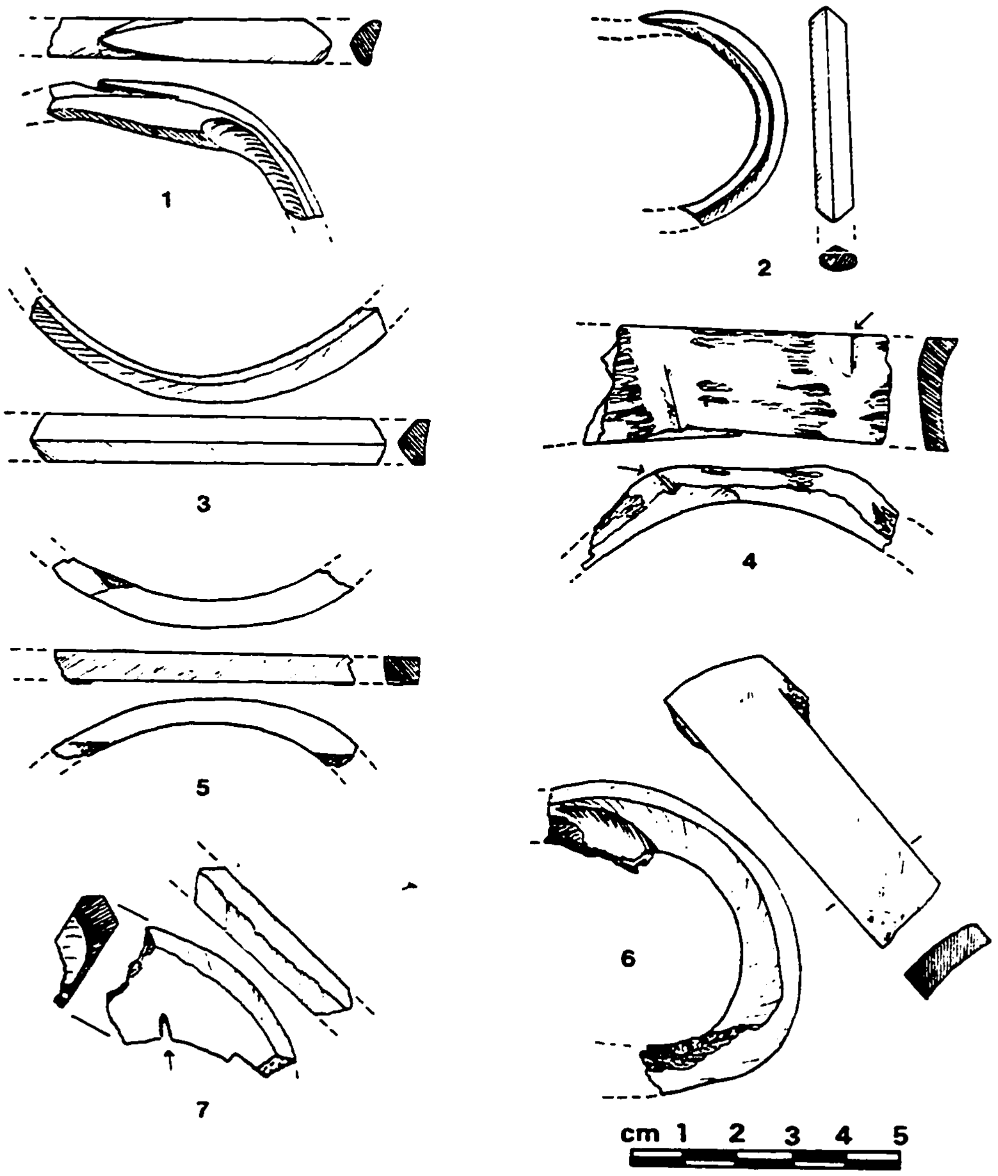
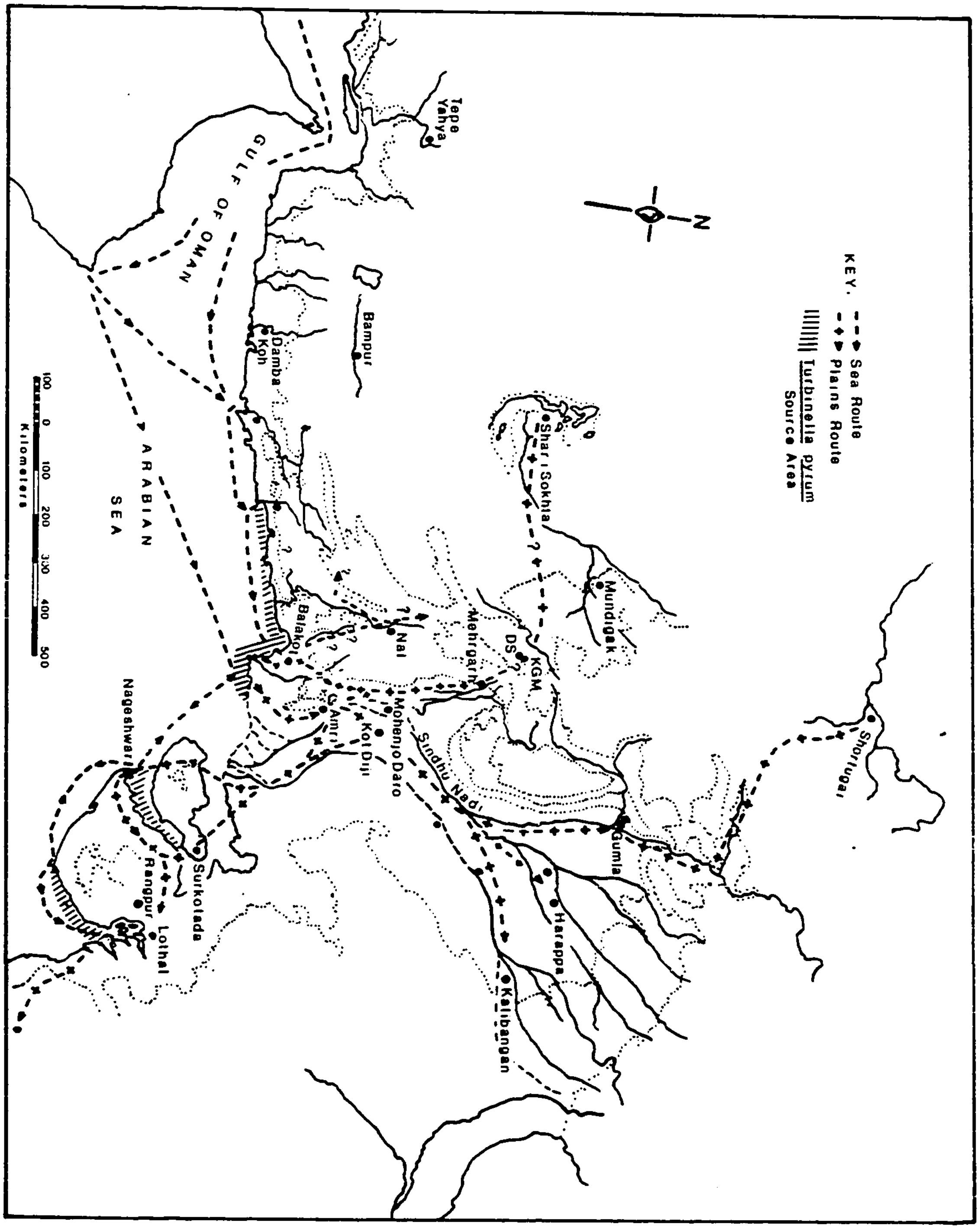


FIGURE 3-28. MAJOR TRADE/EXCHANGE NETWORKS FOR SHELL, MATURE INDUS PERIOD, 2500 TO 1750 B.C.



CHAPTER IV. THE ROLE OF SHELL IN SOUTH ASIA AFTER THE DECLINE OF THE INDUS CIVILIZATION

Archaeological Evidence.

In the previous chapter we followed the development and specialization of shell working for over four thousand years, from the Neolithic to the urban Chalcolithic period. During the urban expansion of the Mature Indus period, the use of shell objects became common at rural as well as urban sites throughout the Sindhu/Nara plain and adjacent regions. Many of these sites were located thousands of kilometers from the sea, and it was only because of a well established system of trade/exchange they were able to obtain raw materials, such as shell, and finished objects. By about 1700 B.C., the centralized administrative structure of the Indus Civilization began to deteriorate, with a decline of the larger urban centers in the nuclear region and a gradual expansion of settlements to the Northeast and Southeast (Wheeler, 1968; Fairservis,1967; Dales,1966; Jarrige,1973; etc.). Coinciding with this expansion and decentralization, regional cultures developed that were no longer linked by long distance trade/exchange systems. As a result, there is limited evidence for cultural or economic ties between Late Indus cultures in the Ganga-Jamuna Doab (Northeastern Region) and Gujarat (Southeastern Region). The breakdown of

these trade networks is seen in divergent styles of ceramics, artifact assemblages and most important for this particular study, the rare occurence of shell artifacts at northern sites.

As was discussed in the previous chapter, shell artifacts are common at Kalibangan during the Mature Indus period, but at other Northeastern sites, shell is quite rare. No shell has been reported from Manda, Jammu State (Joshi and Madhu Bala,IAR 1976-77:19-20), from Chandigarh, Punjab State (IAR 1970-71:7-8), or at Hulas in the Doab (Dikshit,1981:70-76). Instead of shell, faience and terra cotta bangles and beads become the most common ornaments. The Mature Indus occupations at these sites is probably somewhat later than at sites in the central regions, and the absence of shell artifacts may representt the beginning of the deterioration of organized trade/exchange systems.

This pattern continues into the Late Indus period at all of these and numerous other sites throughout the Northern region. Only one exception to this pattern has been noted at the site of Daulatpur, Haryana, where shell bangles are reported from the Late Harappan period I (IAR 1976-77:19).

Recent explorations and excavations in Jammu, Haryana, Punjab and Uttar Pradesh (India) have revealed a large number of Late Indus (Harappan) sites, where there is evidence for overlap with non-Indus cultures. Of these cultures, the most important is characterized by a

diagnostic pottery known as Painted Grey Ware (PGW). Excavations in the Doab at sites such as Alamgirpur, Hulas and Bargaon have shown that the Late Indus (Harappan) of this region can be dated from about 1700 to 1000 B.C. (Dikshit,K.N.,1981:74). In the later levels of some of these sites there is an overlap with PGW occupations (without iron), and these levels are dated from about 1200 to 1000 B.C. (Joshi,1978:101; Lal, B.B.,1981). Other important sites that show similar intermixing of Late Indus and PGW material culture are Dhaderi, Bhagawanpura and Sanghol (IAR,1975-76; 76-77; 77-78; Joshi,1978).

There has been considerable discussion regarding the identity of the people who used Painted Grey Ware (Shaffer,1981), but generally speaking they can be said to represent the acculturated Aryan tribes referred to in the Mahābhārata Epic (Lal,B.B.,1981). The relative dating of many sites is still controversial because no detailed comparative studies have been made of the primary data. Nevertheless, certain general patterns regarding shell artifacts can be noted, in that little or no marine shell artifacts are found at northern sites from the Late Indus period to the early PGW levels.

Again, there is some controversy about the chronological span of the PGW culture and though at major sites such as Hastinapura it continues till about 800 B.C. (Lal,B.B.,1981:30), at smaller sites such as Ganwaria it may last until 600 B.C. (Lal, M.,1979-80:72). In the upper PGW

levels iron becomes quite common, and with this change in metal technology we see the appearance of an important new type of pottery called Nothern Black Polished Ware (NBP). Some sites showing the transition from PGW to NBP Ware are Raja Karna Ka Qila (IAR 1970-71:15-16) and Ganwaria (IAR 1976-77:50-52). The discovery of NBP wares in the lowest levels of important urban centers that are mentioned in the Ramayana Epic have resulted in the association of this ware with the peoples and events described in the Epic (Lal,B.B., 1981). The use of NBP wares continues for quite a long time, and because of the apparent time lag in the diffusion of iron technology and associated NBP pottery to the Eastern and Southern regions, most scholars agree on a division of this tradition into Early, Middle and Late phases, with Early NBP beginning at the end of the Eighth Century B.C.(Lal,1981:31). During the Early NBP phase at sites such as Masaon (IAR 1970-71:38-39), Prahladpur (IAR 1962-63), Mathura, Periods I and II (IAR 1975-76:53-55), Ganwaria (1976-77:50-52) , Ujjain (IAR 1956-57:27), etc. we find the first evidence for the resumption of the use of shell artifacts after more than 1000 years. A wide variety of decorated bangles and beads has been reported along with one example of an imitation conch trumpet from the site of Ganwaria (IAR,1976-77:Pl.XLVI,D). A possible implication of this terra cotta replica is that conch shell objects were in demand, but that there was insufficient supply from the coastal regions. Later, when trade routes were firmly

established during the Mauryan period, shell artifacts become quite common at all inland sites.

In contrast to the Northern sites, most of the surveys in Gujarat show a continuity in the manufacture and use of shell from the Late Indus period right through to the Early Historic period. At the site of Rangpur, we have noted the use of shell beads in the post Indus occupation (Period III) that is dated from 1500 to 1300 B.C. (revised dating by Rao,1979:45). Numerous other sites with Late and Post Indus (Harappan) occupations provide further evidence for this continuity (Table 4-1).

TABLE 4-1. GUJARAT, IMPORTANT LATE AND POST-INDUS SITES WITH SHELL ARTIFACTS.

Site, District	Period	Shell Artifacts	Reference
Pabumath, Kutch	Late Indus	Bangles, beads	(IAR 1977-78:21)
Rojdi, Rajkot	Mature and Late Indus	Bangles	(IAR 1962-63:7)
Pithiadia, Madhya S.	Mature and Late Indus	Bangles	(IAR 1957-58:20)
Kanewal, Kheda	Mature and Late Indus	Bangles, beads	(IAR 1977-78:21)
Amra, Jamnagar	Late and Post Indus	Bangles	K.Bhan, Ph.D.Diss. M.S.Univ. Baroda
Kota,	Late Indus	Bangles	K. Bhan

Jamnagar			
Oliva Peer	Late Indus	Bangles	K.Bhan
Jamnagar			
Beraj-no-timbo	Late and	Bangles	K. Bhan
Jamnagar	Post Indus		
Morpura	Late and	Bangles	K. Bhan
Jamnagar	Post Indus		

Although this continuity is seen primarily at coastal sites, we also see it occuring at some inland sites that apparently had socio-economic contacts with the Late and Post Indus cultures of Kutch and Kathiawar. At Eran (Dist.Sagar, M.P.) marine shell artifacts, particularly bangles of T.pyrum, are reported from the Chalcolithic period I (1500 to 1300 B.C.) and Period II (1270 to 1040 B.C.)(Bajpai, IAR 1960-61:17-18; IAR 1965-66:87). The discovery in Period II of a Brahmi inscription possibly written during the Mauryan Period (300 B.C) suggests that the C14 dates may be slightly early.

Similarly, at the site of Ahar (Dist. Udaipur, Rajasthan), shell bangles are found in the Chalcolithic levels (c. 1750 B.C.) and also in the Early Historic levels, where they are associated with NBP ware (post 1200 B.C.) (IAR 1961-62:45; Sankhalia,1963). I have not been able to examine any of the shell artifacts from the above mentioned sites, but fortunately I was able to make a detailed study of important collections from Early Historic sites excavated by Professor R.N.Mehta and his collegues

from Maharaja Sayaji Rao University, Baroda. At the site of Nagara (Kheda District, Gujarat) shell bangles occur in Period I (600 to 200 B.C.), Period II (200 B.C. to A.D. 0). Period III (A.D. 0 to 900) and Period IV (A.D. 1300 and later) (Mehta, IAR 1963-64:9-10). During the Early Historic periods (I to III) bangles were decorated with single wide channel grooves (as at Lothal), wide double shallow grooves (as at Lothal and Surkotada), multiple deep grooves and a wide variety of decorative geometric and floral motifs (IAR 1964-65:Pl, IX, B). Other shell objects include rings, beads and pendants. Similar types of artifacts and designs are also found at the site of Vadnagar during the Early Historic Period (Subha Rao and Mehta,1955). All of these shell artifacts were being made from Turbinella pyrum and the presence of large amounts of manufacturing wasters suggests that they were produced at both sites. A study of the sawn manufacturing wastes shows that the saw used to cut the shells had a convex cutting edge that was approximately .65 mm in thickness (Table 4-2).

TABLE 4-2. VADNAGAR AND NAGARA; SAW CUT MEASUREMENTS.

N = 21	mean=.95	min = .70 mm	Estimated width
	s.d.=.14	max = 1.45 mm	of Saw Edge = .65 mm

This saw was undoubtedly made from iron rather than copper/bronze, but the striae on the shells indicate that is was bilaterally denticulate, cutting in both directions. Basically, the techniques used for chipping and sawing the

shells were identical to those developed in the Lower Sindhu/Nara plain over two thousand years earlier.

Very little research has been done on the Late and Post Indus period in Lower Sindh, but it is more than likely that when sites are discovered, we will see a continuity in the manufacture and use of shell, as has been seen in our discussion of Gujarat. The only major excavations that provide any evidence for the use of shell in this region are at sites such as Banbhore, which was inhabited during the Early Historic Period (about 100 B.C.) (Pakistan Archaeology, 1964:49-55). This site has been identified as the ancient Hindu/Buddhist port of Debal, and vast amounts of shell working debris have been found on the western side of the city, inside the defensive wall (personal observation). Later on this site was conquered by Mohammad Bin Qasim (A.D.712) during the Muslim conquest of Sindh (Ibid.)

In Northern Pakistan, at the site of Sarai Khola there is evidence for the use of shell bangles in Period IV which has tentatively been dated to the early Medieval period (A.D. 700 -800)(Halim, 1972:23-89). In these levels, numerous shell bangles, beads and pendants have been discovered (Fig.3-4;2-9). No manufacturing waste was found at the site, but at the nearby site of Taxila, there is abundant evidence for the manufacture and use of shell from the Early Mauryan and Sunga Periods (300 to 100 B.C.) (Marshall,1951). Incised bangles found in the Mauryan

levels have simple designs like the "X" motif seen on the bangles from Sarai Khola, as well as a wide range of decorative geometric and floral motifs (Ibid.,Vol.1:667; Vol.3:Pl.201,202). Most of these artifacts were made from Turbinella pyrum, but other partly modified and unmodified marine species have also been found (Ibid.) Taxila was one of the most important administrative and religious centers of the Northwestern region, and the presence of a wide variety of shell species can be attributed to its important commercial contacts with sites such as Debal (Banbhore) on the Karachi coast, as well as sites in Gujarat and South India (Majumdar, R.C.,1951).

No detailed comparative study has been made of the shell artifacts from NBP and Early Historic sites, but important chronological and regional variations undoubtedly exist. In his recent study of ornaments and special objects from Early Historic sites, C. Margabandhu suggests that the wide variety of decorative motifs on bangles only become common in the 2nd century B.C. (Unpublished Dissertation, personal communication). He notes that the simpler designs, such as a single wide channel groove and multiple deep grooves, occur much earlier. In Gujarat a similar pattern can be noted in the early appearance of these same simpler designs during the Late and Post Indus periods and the occurance of more elaborate motifs during the Early Historic Period, around 600 to 200 B.C. Possibly these complex designs were made in imitation of gold and silver ornaments.

The object of this brief and very general survey has been to illustrate the preservation and continuity of shell working traditions in Gujarat, from the Mature Indus to the Early Historic Period, and to show how there is a discontinuity in the Northern regions. Shell ornaments only become common in the Northern sites during the second major urbanization of South Asia, when republics and kingdoms were established around 600 B.C. (Thapar, R.,1966:50). The importance of shell working became even more firmly established during the Mauryan Period, when we find reference to the special "Superintendant of Mines" who was appointed for administering the mining of conch shells, pearls and oysters from the ocean (in Kautilya's _Arthaśāstra_, cf.Keny,1972:31). At last, after a long silence during the protohistoric period, there are textual sources that discuss the socio-economic and socio-ritual importance of shell objects.

Early Textual References.

The earliest known text from South Asia is the _Ṛg Veda_, a collection of hymns composed by the early Indo-Aryan speaking peoples who gradually migrated into the nothern plains. The composition of these songs can be dated around 2000 to 1600 B.C. on the basis of comparative linguistic evidence (Renou,1954:176). Unfortunately, there is no mention of shell in any of these songs, but in the _Atharva Veda_, a ritualistic text that was composed somewhat later

(circa 1400 B.C.,Ibid.), there is reference to the use of "pearl-shell" as an amulet to ward off evil (cf.MacDonnell and Keith, 1920:350; Lanman in Whitney,p.161, Atharva Veda iv.10,1). It is not surprising to find mention of shell in this text, since there is archaeological evidence for the widespread use of shell in the mountainous regions of Baluchistan during the Early Chalcolithic and Proto Historic periods. The predecessors of the early Indo-Aryan tribes who eventually settled down in the Sub-continent must have passed through these regions, and apparently adopted some ritualistic beliefs regarding the use of shell. However, the minimal reference to shell objects indicates that they were not common. The absence of shell artifacts at Late Indus and Post Indus sites in Northern India and Pakistan appears to correlate with the lack of textual references during approximately the same time period.

Numerous discussions have been raised about the expansion of Indo-Aryan speaking peoples and M.C. Joshi's interpretation seems most plausible.

> "So far as the authors of the Atharva Veda or reference to associated culture in it are concerned, it may be stated that people connected with it were broadly of the same group which composed the other Vedas and were not invaders at all. By the time Vedas were composed, their authors had already become Indians even if they were migrants. Besides, it has to be always kept in mind that Aryan or the people associated with Vedic cultures had much diversity amongst themselves, for their settlements were distributed over a vast area, in small geographical units " (M.C.Joshi,in Devi Chand, 1982).

The following era, as related by the Mahābhārata and Rāmāyaṇa Epics, represents a long period during which these

early Aryan settlements developed into urban centers and Indo-Aryan language and culture spread throughout the Northern Sub-Continent. This process of cultural integration is evidenced in the Epics, where many new beliefs and customs are described that do not relate to the earlier Vedic traditions (Renou,1954; etc.). In sharp contrast to the Vedic texts, there are numerous references to the use of shell in the Epic literature. The shell most commonly mentioned is the *śankha* or conch shell *Turbinella pyrum*. Actually this word appears to have had many different connotations, and may have been used to refer to other large gastropods but the fact remains, that shell artifacts found at NBP ware and Early Historic sites are almost exclusively made from *Turbinella pyrum* . Furthermore, iconographic representations of the *sankha* can invariably be identified as *T. pyrum*.

In the *Mahābhārata*, women are described wearing beautifully carved conch bangles (*Mahābhārata*, Chap.4,15.2) and in the *Bhāgavad Gita* there is a lengthy description of the conch trumpets sounded by each hero before the great battle of Kurukshetra; Panchājanya blown by Sri Kṛṣṇa, Devādatta blown by Arjuna, Paundra blown by Bhima, etc. (*Mahābhārata*, *Bhāgavad Gita*,1,12-18). The conch shell was also used as a ritual libation vessel, and is specifically mentioned in the coronation of Yudhiṣthira when Sri Kṛṣṇa anointed him with holy water (*Mahābhārata*, *ShantiParvan*,

12,40.11). In the Rāmāyaṇa most references to śankha are descriptive references to its use as a trumpet or to its special form (Vālmiki-Rāmāyaṇa,VI.60.42d, etc., cf. G.H.Bhatt,1966:Vol.II). These and numerous other references illustrate the three most important uses of shell during the early Epic period; as an ornament, as a trumpet and as a ritual libation vessel. These important socio-ritual uses of shell were undoubtedly adopted by the Aryan peoples as they spread throughout the Sub-Continent and there is no evidence for their origin being in the distant Indo-Aryan homeland (wherever that might have been).

Some clues regarding the processes whereby these customs were assimilated are seen in the Mahābhārata itself, as well as in later texts. The Brahma Vaivarta Purāṇa (compiled about 400 A.D., cf.Renou,1954:177) relates the story of how the śankha or conch shell was created from the bones of the demon Śankhācuda. After a long drawn out battle, involving myriads of minor gods and demons, the great god Śiva, with help from Viṣṇu finally managed to destroy the Śankhācuda. Out of compassion he threw his whitened bones into the salt sea where they were transformed into the brilliant white conch shell (Brh. V. Purāṇa, Prakriti Khanda,Chap.20:23-24). The text goes on to describe the uses of the conch shell.

> "The water of the conches is very holy, and propitiates the gods. For worship of all gods except Śiva the water of the conches is sacred like the water of a place where pilgrims resort. Nay, the place where conches are sounded is the constant resort of Laksmi. Whoever bathes in the

waters of the conches reaps the benefits of bathing in all sacred rivers. Hari always resides in the conches and in places where conches are sounded. Such places are always free from evil. But where conches are sounded by women and Sudras, Laksmi sadly and angrily leaves that place" (Ibid.).

The most important quality of the conch is its purity. Whatever touches the shell becomes pure, and even the sound produced by blowing the shell is powerful enough to dispell all evil. With the sound of the conch a worshiper prepares the place of sacrifice and calls the gods to accept their share.

Another important legend is the account of how Sri Kṛṣṇa vanquished the demon called Panchājana (Mahabharata,VII.10.20). This demon had been making a nuisance of himself among Sri Kṛṣṇa's people, and Kṛṣṇa was forced to destroy him. When the demon realized that he was doomed, he fled to his conch shell abode in the sea near Kathiawar, but Kṛṣṇa followed him into the sea and dispatched him. Claiming the conch shell as a trophy, he named it Panchājanya. In the course of Kṛṣṇa's deification as an avatar of Viṣṇu, this conch shell became an important emblem of godhead, and iconographically, most representations of Viṣṇu hold a conch shell in their left hands (Desai,1973).

Our concern with these legends is that they may represent later interpretations of events surrounding the conquest of indigenous groups who used the conch shell as their totem, or the spiritual conquest whereby the ritual significance of the conch shell was assimilated into the

religious symbolism of the Brahmanic tradition. We know from the archaeological record, that conch shells (*Turbinella pyrum*) were used continuously in the regions of Kutch and Kathiawar, and one of their main sources is right near Krsna's capital city, Dwarka. It is quite clear from the archaeological record, that shell working traditions were adopted by Early Historic peoples from the indigenous culture. Perhaps the concept of purity and other attributes of the white shell were also adopted along with the technological and stylistic aspects of the industry.

The Conch Shell Industry of Bengal

At present the only manufacturing centers producing bangles and other ornaments from *Turbinella pyrum* are found in the Bengali speaking regions of Eastern India and Bangladesh. Although these centers are over 2000 kilometers from the source areas for this shell, there is archaeological and historical evidence for the use and manufacture of shell ornaments from as early as the Magadha Period, about 500 B.C. These traditions became even more widespread during the following centuries and are well documented from excavations of the Gupta Period (i.e. Chandrakhetugarh, 400 to 600 A.D., IAR 1963-64). It is not surprising that this industry came to be established so far from the source of the raw material, since important trade emporiums developed all along the Ganga River and its delta with the rise of early kingdoms. The modern Indian states of Bihar and West Bengal, and the nation of Bangladesh, were

collectively referred to in the early literature as Anga and Vanga (Law,1920:204-207,267-268). The various commercial centers in these regions were the easternmost depots of a vast trade network that traversed the entire subcontinent. In addition to internal trade, these centers were involved in commerce with Assam, Southeast Asia, Bhutan and Tibet (Keny,1972; Acharya,1972). Therefore it is quite understandable that shell workers and traders were attracted to cities such as Pataliputra and Champa, bringing with them traditions and techniques that were already well established in Western India.

In the course of history, numerous commercial centers have risen and disappeared with the rise and fall of kingdoms or the changing courses of rivers. During the 16th and 17th centuries A.D., at the height of the Mughal Empire, riverine ports in the Ganges Delta, such as Pabna and Dhaka (Dacca), had become important international ports. From the reports of early European travellers, such as the Tavernier, we know that these cities were also important centers for the manufacture and trade in shell ornaments (Ball,1925; see Hornell, 1914 for discussion). Shell working was also being carried out at this same time in Western and Southern India, but their markets slowly began to dwindle, so that by the late 19th century the shell industry had almost completely disappeared in these regions. According to the Bombay Gazetteer of 1884, the practice of manufacturing bangles had died out in Junagadh, Gujarat by the mid-1800's. "Three

local industries have lately died out, shell bracelet making, ivory inlaying and handloom weaving. Bracelets were formerly made of conch shells, but the use of shell has almost entirely given place to ivory" (1884:261). I visited the same town in 1982,to try and see if I could find any of these ancient shell workshops, but I could not even locate ivory bangle makers, as their trade has been swallowed up by cheaper imitations in hard plastic. There were undoubtedly many complex economic, social and religious factors responsible for the decline of shell bangle production and use, but the end result was that the women in these regions no longer required shell ornaments. Ivory ,glass, and now plastic ornaments that have replaced shell, occasionally retain some of the ritual importance that shell had and this can be seen in the role of these bangles in marriage rituals throughout India. In Bengal, however, Hindu women have still retained the ancient tradition of wearing the sacred conch bangles, both men and women still wear conch rings for their purifying quality and the use of conch shell in many other forms plays an important part of everyday practices and rituals. It is the strong adherance to these beliefs that has been the most important factor in keeping the shell industry alive in Bengal(see Hornell,1914:99-105 for further discussion).

The artisans who manufacture shell objects generally belong to the Śankhari sub-caste (syn. Śankhakar or Śankhabanik), which is a part of the larger Vaisya caste

(Riseley,1982:221-224). Several other sub-castes occasionally engage in shell working or activities related to the reprocessing of waste materials, but these are not their traditional occupations (Sen and Sinha,1961). Legends regarding the origins of the Śankhari sub-caste are similar to those of other artisans, such as goldsmiths and jewelers. These legends serve to insure a secure position and define social obligations within the larger context of Hindu society, and they do not appear to have any archaeological significance for understanding the role of shell working in the prehistoric period. Within the Śankhari sub-caste itself, there are many internal divisions relating to specific jobs in the production of shell objects. Some of these have become almost hereditary, such as collecting shell wasters for the production of lime, while others are dependant upon an individuals skill and artistic ability. Most production is done by male family members, but in West Bengal, women also participate in the less arduous tasks, such as grinding, carving and polishing the ornaments. Many of these social systems are not visible in the patterning of archaeological materials and since they have been fully discussed by other scholars (Hornell,1914; Sen and Sinha,1961) they need not be discussed here. Up until the last century, small communities of Śankharis could be found in most of the rural market villages as well as in the larger urban centers. Presently, the introduction of electric saws and grinding wheels has begun to revolutionize

this industry, not only in terms of manufacturing techniques, but also in the concentration of manufacturing centers in the major cities. Calcutta and Dhaka have always attracted large communities of Śankharis because of their central location, but recent changes in technology and the distribution of shell raw materials are forcing many of the rural manufacturing centers to either close up or move to the city. Increased education among the younger generation has also contributed greatly to the decline in production, but fortunately there are a few skilled artisans who practice the traditional methods of manufacture. In the following section I will briefly outline the main aspects of the industry, concentrating on specific socio-economic aspects related to collection and distribution of raw materials, tools and manufacturing technology, marketing and also the ritual uses of shell objects. By determining the relationship between artifact types and their distribution at different sites, it is possible to develop more reliable interpretive models for better understanding the protohistoric industry.

Ethnographic Study.

In order to understand the variation within the major tradition of shell working, I selected four different communities for observation; the Sankharis of Barrackpore, Bishnupur , Hatgram and North Calcutta. At Barrackpore, which is just outside of Calcutta, the Śankharis are migrants from Dhaka who were settled in this location after

the Partition of India and Pakistan in 1947. About forty families presently live in one distinct neighborhood and their manufacturing techniques and styles represent the traditions of East Bengal. Dhaka has been a major center for the production and trade of shell objects for over 400 years (Hornell,1914). The town of Bishnupur (Bankura District) is located some 170 kilometers northeast of Calcutta and its Śankharis exemplify the West Bengal tradition. This town was a capitol of the Malla kings and has been an important religious center since the 9th or 10th century A.D.(Oster,1980:25). Hatgram is a smaller village in the Indpur Subdivision of Bankura District some 55 kilometers further northeast. It has been an important rural manufacturing center for the last 400 years, since the Sankharis fled there from a neighboring kingdom to escape the wrath of their king. The tradition represented at Hatgram is basically similar to that of Bishnupur, but because of its peripheral location near the Santhal and Bhil tribal areas, it produces specific objects for rural and tribal markets that are not produced in the other centers. The last center is Calcutta, and though there are several different localities with shell workers, North Calcutta (around Amherst St.) has the largest concentration of workshops and provides a more representative picture of the urbanized shell industry. In this area there are families who have moved to the city from both East and West Bengal, and the objects sold in their shops are often brought from

the rural workshops to cater to the demands of migrant workers and the wide variety of communities present in the city.

Collection and Distribution of Raw Materials.

Shell raw materials being processed in the workshops of Bengal are collected from two major source areas; the waters of South India and Sri Lanka, and the Gulf of Kutch (see Chap.II; also Hornell,1914). In South India and Sri Lanka, shell fishing is done by specialized communities of divers who also engage in pearl fishing. Hornell (1914) has discussed the numerous variations in methods of shell collection, and these can be grouped into three basic techniques; diving, wading and collecting sub-fossil shells buried in the sand. This last method is done only in Jaffna Lagoon, Sri Lanka (Ibid.:40). The most common method in South India is diving from boats in the shallow littoral waters, where shell beds lie at 3 to 10 fathoms. These beds are often as much as 10 to 20 kilometers from the shore and the divers sail out in the early morning and dive from about 7 AM to 1 PM (Ibid.:16-17). Sharks do not present a problem, but with the approach of the Southwest monsoon, winds and currents bring in vast shoals of poisonous medusae and siphonophores (i.e. Physalia or Portuguese Man-o-war). The appearance of these creatures effectively puts an end to diving (Ibid.:16-21). Generally speaking the fishing season begins in October, at the end of the monsoon and continues till May, when it begins again. However, minor variations

in the weather can make diving very dangerous and consequently collection is often irregular.

Fishing rights are controlled by the government and specific shell beds are leased out to individuals who in turn employ local divers on commission. The value of each shell depends on its size and the presence or absence of worm holes. Larger shells without worm holes fetch the highest price and wormed shells are often not purchased at all. Undersized shells, less than 7 cm in diameter are confiscated to deter the divers from collecting immature specimens. But, in the end, merchants collect all the shells for shipment to inland manufacturing centers regardless of their quality (Ibid.:25). The meat of the mollusc is extracted by the divers on their way back to shore and either consumed at home or sold in the local market. Incense manufacturers purchase the opercula for use as an adhesive, so essentially every part of the mollusc is utilised (Ibid.:171).

Although some wading is done along the southern coasts, this technique is more common in the Gulf of Kutch, where the waters are colder and there is lower visibility. Some of the shells are collected by shallow dives in the process of pearl fishing, but generally they are collected from the reefs or shallow waters at low tide. At present, because of the less organized nature of collection, fewer quantities are collected from the Gulf. Sometimes these shells are sold to the local Fisheries representative, who grades them

in the same manner as discussed above, or else to local merchants, who sell them to pilgrims. In Bengal, shells from Kutch are called <u>surati</u> <u>śankha</u> and are prized for their pure white color and heavy shell. The use of this name came about because the shells were shipped overland to Calcutta from the port of Surat in the Gulf of Khambat. This port is no longer an important trading center, and merchants from Bombay or South India come to the Fisheries auction in Okha and purchase the entire stock, generally for incorporation into their shipments from the Southern sources.

Because of the large quantities of shells being shipped from South India, the merchants are able to mix in many wormed and undersized shells, so that the distributers in Calcutta are stuck with a lot of worthless raw materials. Most of these defective shells are passed on to the smaller producers by repacking the raw materials. Generally, in one bag of 200 shells, 12% are good quality, 25% are medium quality and the rest are worthless, at least for bangle manufacture (A.K.Nandi, Bishnupur, personal communication). Many different names are given to the shells depending on their shape, structure size and color. Although I was not able to make a comparaive study of all the different classifications, discussions with merchants in Barrackpore and Calcutta indicated that they had more subjective criteria for sorting than the merchants in Bishnupur or Hatgram (Table 4-3). These differences are undoubtedly related the fact that Calcutta is the major port of entry

for the raw materials and more shells are processed in the urban workshops. However, these specialized classifications are not readily apparent in the final distribution of raw materials between the urban and rural market centers because they are highly subjective.

TABLE 4-3. BENGAL; BASIC SIZE CATEGORIES FOR Turbinella pyrum.

WEST BENGAL	EAST BENGAL	AVERAGE MAXIMUM DIAMETER
Māthā	Mājhār	70 tp 90 mm
Ḍep	Ḍep >	50 to 60 mm
	Dābā >	
	Ukhār >	
Kuloi	Kuloi	Less than 50 mm

Along with Turbinella pyrum, the merchants in Calcutta also import many smaller marine species for sale as curiosities. Some of these species are distributed to the rural market centers, but since there is less demand for such knicknacks in the rural areas, fewer varieties are represented.

Distribution of raw materials is intricately related to the distribution of finished products. Both are a function of the socio-economic status of an individual, as well as the amount of capital available to him. In traditional Bengal, caste and family ties are often more important than capital, so that even if a person has a lot of cash, it is usually impossible to break into the system of distribution established along social interaction networks. Within the

established system there are more powerful and less powerful families. Most of the businesses in Calcutta are run by very old families with branches in every major city throughout Bengal and even in other parts of India. These merchants control the import of shells and some even lease the actual fishing grounds in South India. Others have tried to force their dependent manufacturers to move to South India in order to avoid the cost of shipping the raw materials, but these innovative attempts have failed because the workers got too homesick for Bengal.

In order to control the final distribution of finished products, the large merchants distribute most of the raw materials to skilled artisans who process the shells on commission. A bag of shells is given to a sawer to cut, then the bangle blanks are given to a grinder to shape and carve and finally they are returned to the merchant. These finished goods are then sold from his own store or exported to other cities, where the presence of a large Bengali community creates a small demand. One ironic twist in this process is seen in the sale of conch shell products to Bengali pilgrims who travel to Rameshwaram in South India, or to Dwarka, in Kathiawar. Originally the shells are from coasts near these important pilgimage centers, but they are then sent to Bengal for manufacture and finally brought back in finished form to be sold, almost exclusively to pious Bengalis.

Smaller merchants who do not control the actual import

of raw shells purchase large quantities of shells and distribute them in the same manner within their own community. The finished products are sold in regional markets or to major exporters. This type of production is seen in Calcutta, Barrackpore and the outlying market towns such as Bishnupur.

A lower level of production is seen primarily in the rural market centers and villages, such as Hatgram and occasionally in Bishnupur. A single family purchases a bag of shells and these are processed entirely by members of the extended family. One or more male members are involved in acquiring the raw materials and marketing the finished products, while all other members are engaged in the actual production. Although any production within the home can be termed a cottage industry, in this discussion, I will use the term specifically to refer to the self contained system where primary raw materials are procured and processed within one extended family. In Hatgram, this type of production is carried out primarily using waste fragments bought from the urban workshops, rather than actual whole shells.

Primary manufacture of shell ornaments is not practiced by itinerant craftsmen, but secondary processing and some marketing is done in this manner. Most families have one or two male members that go to outlying villages to sell their wares door to door, or at village markets. Generally these merchants carry a few bangle blanks and a file so that if a

house wife has broken one bangle and can't afford to buy a new pair, he can quickly make a matching bangle from one of the blanks.

Tools

All of these different communities are engaged primarily in the production of bangles from _T.pyrum_. The techniques and tools used in this manufacture are almost identical, but many of the finished products show distinct regional variations. A wide range of metal tools are used in the manufacture of shell bangles, and many are designed and produced by blacksmiths specifically for Sankharis. Two types of hammers are used for chipping the shell, both have a flat square back, but one is chisel ended (_kurā_) and the other is pointed (_chukā kurā_)(Fig.4-1;1). The _kura_ weighs from 50 to 70 grams and the _chukā kurā_ is generally about 70 grams. A specilaized saw called a _kuṣ korāt_ is used for cutting the hard shell (Fig.4-1;2,3). According to tradition, this saw was designed by the great sage Agastya Muni and fashioned by the celestial architect Visvakarma. The denticulated edge is supposedly modeled after the _kuṣ_ grass (_Poa cynosuroides_) that is noted for its sharp toothed edge. These saws are made from several pieces of iron that have been joined together to produce a very specialized and efficient cutting tool. Only a few workshops still make these saws and when a new saw is needed, a skilled artisan travels to the blacksmiths village which is often in a different region and waits there while the saw is produced.

The entire process will often require three to four weeks, and old saws are generally taken back to the shop to get new cutting edges exposed and to get realigned. The edge of the saw is made from a thin sheet of steel plate that is sandwiched between two heavier iron plates (Fig.4-1:3). Once the three plates have been firmly joined , the center blade is exposed up to three centimeters by shaving away the iron plates. The cutting edge is generally between .4 and .5 mm thick and is convex, with bidirectional denticulations. These denticulations are made by tapping the edge of the blade with a chisel ended adze, beginning first from one side of the saw and then the other. In this manner the edge is provided with an irregular but extremely efficient serration. When the blade becomes dull, it takes about 5 to 10 minutes to resharpen the denticulation, but after repeated sharpening the edge is eventually worn down. When this happens, the interior steel sheet, which is usually 9 to 12 cm broad, is further exposed by shaving away the iron casing. This process can be repeated three or four times, after which the saw must be rebuilt entirely. Other special features of the construction are two antennae-like handles that serve to provide a counterbalance when the saw is in motion. Two hooks located at either end are used as hand supports when sharpening the blade, but they also provide extra leverage when correcting the alignment of the blade. The average weight of a saw depends on the strength of the craftsman and the age of the saw, but usually they

average about five kilograms. When sawing, the blade is often moistened with "ghee" (clarified butter), and with this minimal amount of lubrication, the structural balance of the saw allows it to be moved back and forth in a smooth pendulum like motion. Because of its weight, very little added pressure is needed to cut into the shell. The maximum depth that the saw can cut on each thrust is about .5 mm, which is identical to what was seen on some of the ancient shell wasters from the Indus period. The width of the saw cuts made by different saws was recorded and compared with the actual thickness of the saws (Appendix 4:3). The resulting ratio of saw thickness to saw cut is 1:1.45.

Several smaller hand saws are used for incising and carving decorations on the bangles. These saws are made from a single sheet of metal and though the shapes vary considerably (Fig.4-1;7) they all have a relatively thick cutting edge (1.8 to 3 mm) that is bidirectionaly denticulated. Numerous shapes and sizes of files are used in carving special types of designs, but usually a square or triangular file is used for general incising. For carving low relief, floral and anthropomorphic motifs, sharp awls or chisels are required, and these have a wide range of tips according to the type of design being produced. One other tool commonly used in the decoration of the ornaments is a pump-drill with a steel tip. The tip is sharpened or modified to produce wide shallow holes for setting gems, tiny holes for joining broken pieces, or double rings to

serve as eye motifs. Some of these tools are made or modified by the shell workers themselves, according to their specific needs, while others are bought from local suppliers.

For grinding the interior of the bangle, a special mandrel is made by coating a wooden rod with a heated mixture of coarse sand and lac (Fig.4-1;5). When the lac cools, it hardens into a very effective abrasive surface, but because of the amount of heat produced through the friction of grinding, the rod must continuously be splashed with water. This water also serves as a lubricant and washes away the ground shell paste. Flat sandstone slabs are used for grinding the exterior of the bangles (Fig.4-1;6), and these are obtained from various regional sources famous for their special types and grades of stone. In the past the final polishing of the bangles was done using fine ground brick dust as an abrasive, but now, a glossy polish is obtained by dipping the bangles into a hot, dilute acetic acid (Fig.4-1;8).

Manufacturing Techniques

Basically, the technique for chipping and sawing the shell is identical to what was described for the Mature Indus period, the only difference being that iron instead of copper/bronze tools are used. First, the thin outer lip is chipped away with the chisel end of the smaller hammer (kurā) and then the apex is smashed with the flat end. With the pointed hammer (chukā kurā), the internal septa are

broken to free the columella, but occasionally on large shells, a hammer and chisel are used because of the thickness of the last septa. This same technique was used in the Indus period. Once the shell has been prepared in this manner, the anterior portion is removed by sawing around the shell and snapping off the columella. Sawing is done by extremely skilled workmen who have developed the technique and stamina to hold the shell with their feet and manipulate the saw with their hands. This is done by bracing the back against a short post set into the floor and pressing the shell against a similar post set at about one cubits length from the other (one cubit = elbow to tip of finger). The shell is supported on a soft pile of rags and shell dust and held tightly against the post with the heel of one foot and the toes of the other. (The prehensile ability of the foot is definitely culturally determined). In this extremely awkward position (even they say so) the craftsman gently places the saw against the shell and begins by incising a groove. Once the groove is deep enough to firmly hold the edge of the saw, is is moved with a full arm motion, back and forth. Because of the precarious position of the toe and heel, accidents do occur, and workmen often protect their feet by wrapping them in rags. After the saw has cut through the thickness of the body whorl, the shell is turned and the cut is extended on around the periphery of the whorl. In Bishnupur the men I observed all turned the shell clockwise and extended the cut in the opposite

direction, but at Barrackpore the directions were reversed. There does not seem to be any technological basis for these variations, and they do not change the shape or quality of the finished product. Furthermore, I was unable to differentiate the two techniques on the basis of the sawing striae because of occasional reversals and the overlapping back and forth movements of the saw.

As the saw cut is extended, a tiny wooden splinter is wedged into the the space to keep the saw from being pinched and to avoid cracking the shell by pressure from the foot-vise. This preliminary sawing is called bor kholā and usually a whole pile of shells is processed by one person, before sawing the bangle blanks, which is called rekh kātā. Generally, the saw is sharpened once before beginning, and then once or twice during the day. In one instance, Ramjoy Sen of Barrackpore began sawing at 9:AM and took a break to sharpen his saw and have a smoke at 10:30 AM. During this hour and a half, he had cut the anterior off of 30 small shells at an average of 3 minutes per shell. Larger shells require a considerably longer amount of time due to the thickness of the body whorl and the strong columella. Some of the larger shells cut in timed experiments by the same artisan required 17 minutes, just to remove the anterior (Table 4-4).

Cutting the bangle blanks is just as time consuming, and requires considerably more skill. A special circular wooden piece is placed against the open end of the hollow

shell to provide a better grip, and the apex is placed against the short post. Each bangle blank is removed starting from the anterior end of the shell until only the apex remains. A good artisan can saw completely around the shell producing a bangle that is basically uniform in width, with 1 to 3 mm variation. Again, the time required to cut each circlet varies according to the size and thickness of the shell, but on the average it takes about 8 minutes per bangle (Table 4-4).

TABLE 4-4. BENGAL; SAWING TIME.

	N	Mean Time	St.D.	
Sawing				
Anterior	10	524 sec.	258	Min = 270 (4.5)
		(8.7 min.)		Max = 1060 (17)
Sawing				
Bangles	39	481 sec.	529	Min = 180 (3.0)
		(8. min.)		Max = 780 (13)

Because of the stamina and skill required to saw for long hours, these artisans begin developing their body from a young age, but hardly any boys are learning this trade now, due to the introduction of electric power saws and increased education.

Once the bangle blanks have been sawn, they are given to other workmen/women for further processing. Generally one individual will grind the bangle blanks and carve the designs to produce a set number of bangles. Because of the

relatively fragile nature of the shell circlet, the bangle is supported on a wooden rod that is braced with a special perforated wooden stand (Fig.4-1:7). Bangles are always produced in sets of two (or more) because of social taboos against wearing only one conch bangle. Grinding and carving simple designs does not take much artistic skill, and the average worker can produce 15 to 20 pairs of bangles in one day. Special motifs require a sense of design and proportion, and even though many of these designs are quite standardized, certain individuals specialze in their production.

The percentage of breakage is difficult to estimate, because most of the raw materials are reprocessed, but the causes for breakage are usually related to the poor quality of the raw material and not carelessness of the artisans. I provided several different workmen in both Bishnupur and Barrackpore with whole shells of good and bad quality. Some of the shells were discarded because they were unsuitable for further manufacture. Worm holes were generally the main reason for discarding a shell, but it turns out that certain ecotypes from South India are known for their badly joined sutures, and even though they can be sawn into bangle blanks, these would snap apart during the grinding process. The good quality shells included small as well as extremely large specimens, and various bangle widths were produced from each size group. These bangle blanks were then ground and incised with the traditional Indus period motifs in

order to fully understand the process of manufacture. The weight of finished bangles was compared against the original weight of the unworked (but cleaned) raw shell. Out of 12 shells, a total of 47 bangles was produced (of varying widths), and the mean percentage of finished bangles was only 17.4 % of the original total shell weight. On the average, 4 to 6 bangles ranging from 3 to 5 mm can be cut from a medium sized shell (60 to 70 cms in diameter). But, one wide bangle or as many as nine thin bangles (2 to 3 mm) can also be made from the same size of shell.

Merchants classify bangles on the basis of width, design and the portion of the shell from which they were produced. Bangles cut from near the apex are less valuable, because they are smaller in diameter and have two sutures that are more easily broken. The best bangles are made from the center of the whorl, where the shell is most circular and the thickness is most uniform. Thin bangles generally range from 3 to 5 mm and these are called <u>churi</u>. Most thin bangles are decorated with simple incised lines/grooves or with geometric motifs. <u>Bālā</u> is a wider type of bangle that ranges from 10 to as much as 20 mm in width. These are generally incised with more elaborate floral and geometric motifs. Extremely wide bangles are not usually worn by Bengali women, but they are produced for the Santhal and Bhil tribals. The exterior is incised with geometric designs that are very carelessly executed. A special type of gauntlet made from an entire shell is produced for trade

to Bhutan and Tibet. Similar objects are used by Naga tribals as pendants. Both types of ornaments require slightly different sawing techniques and they are only produced at certain workshops in Calcutta and Dhaka.

Most of the other bangle types can be produced in all of the workshops, but generally different regions are better known for specific types of designs. In Calcutta, the whole range of designs are present because the manufacturers come from different regions. Furthermore, many of the finished ornaments sold in the city are produced in outlying workshops for catering to the demands of migrant communities. However, the urban setting and moderniztion has resulted in the production of a wide variety of new designs to meet the changing tastes of urban ladies. Many of these new designs become popular and spread to the more distant market centers that have strong commercial ties with Calcutta. Nevertheless, both Bishnupur and Barrackpur have their own characteristic traditional designs, and these are preferred by the more conservative families. Barrackpore and Dhaka are known for elaborate geometric and floral designs, while Bishnupur is famous for its low relief carvings of peacocks, other birds, flowers, gods, etc. Hatgram, on the other end of the scale, produces very cheap bangles made from sections cut from recycled wasters and broken bangles. Two or three pieces are joined together with wire and/or lac, then the entire bangle is covered with red colored lac. Multicolored designs are made with green,

yellow and brown lac on top of the red lac and finally a thin line is incised through the colored lac to expose a portion of the ritually important shell. Less elaborate bangles without any coloring at all, are made simply by joining two semicircular fragments with a wire hinge. These piece bangles are sold to tribal women or poor rural women who can't afford or don't care for the more expensive types. Some complete shells are processed at Hatgram, and these are used to make the wide bangles (20 to 30) that are worn by Santhal women. Incised with crude geometric designs, these heavy bangles are worn by unmarried as well as married women, as the Santhals do not follow the same religious codes as the Hindus.

In addition to these various types of ornaments, special ritual bangles are made for ritual use in worship. These are made from tiny circlets cut from small shells or by coating a wire ring with a mixture of shell dust and lac. A thin coat of red color is applied to the exterior edge of each bangle and they are presented to the Goddess during certain rituals.

Bangle Manufacturing Waste

Because of the vast amount of waste resulting from the production of bangles it is not surprising that the industry manages to reutilize most of the larger pieces. Each characteristic waste fragment has a specific name, and though these names vary from region to region, the classifications remain the same; sawn apex (chāli),

columella (<u>geṛā</u>), anterior sawn portion (<u>lenj</u>), sawn body whorl (<u>pāṭā</u>) and broken pieces of sawn bangle blanks(<u>kuchā</u>). Various processes are used to make different objects from each of these pieces and some of these resulting fragments are similar to pieces found in the Indus period. For example, the apex is broken into four pieces to make inlay,the sawn body whorl is often drilled to make perforated discs and rings, the columella is chipped and sawn to make solid gaming pieces or beads. One process that was not seen in the Indus period was the manufacture of piece bangles from broken fragments. In discussing the origins of this production with various older Sankharis it appears that this trend is quite recent, and has only taken hold since Partition. The reasons cited are the lack of good raw materials due to the exclusion of shell from Sri Lankan fisheries. These shells are sold to Bangla Desh, and processed in Dhaka because of India's strict import duties. Due to a lack of good raw materials and inflation, the production of these cheap, piece bangles has become more common.

Nevertheless, reprocessing of waste materials has always been an important facet of the shell industry, to the extent that even tiny chips and shell dust are utilized. These fragments are sold to lime-makers who burn the shell to produce a high grade lime plaster or whitewash. Numerous other uses of the wasters could be discussed, but the important fact is that many fragments manage to make it into

the archaeological record. Because of strict caste divisions, the Sankhari neighborhood is set apart from other qroups, and the actual production is limited to the Sankhari neighborhood, and every part of the Shankhari village shows evidence for shell working; the streets, gullies, courtyards and even kitchens. Shell fragments are found in foundation deposits of older buildings and are often incorporated into the plaster or walls of new buildings. This distribution is slightly less in the adjacent neighborhoods, but I have picked up shell manufacturing waste as much as four kilometers from the workshops.

Other Shell Objects

The same workshops that produce ornaments also manufacture objects such as trumpets and libation vessels. Trumpets are usually made by simply perforating smaller shells or wormed shells that are not suitable for bangle production. Usually the exterior is incised with a simple floral or geometric motif and the worm holes are filled with wax and shell dust. There is , however, a limited demand for more elaborate trumpets made from flawless shells, and some workshops specialize in their production. East Bengal, especially Dhaka, is famous for trumpets carved with intricate floral and geometric designs , whereas trumpets from Bishnupur (West Bengal) are noted for their elaborate mythological scenes. Both types of trumpets are extremely valuable because of the quality of the raw material and the time involved in manufacture, which can be as much as three

months for the more elaborate scenes. The carving is generally done on a part time basis by artisans who work primarily in decorating bangles or other ornaments.

Two types of libation vessels are produced, one is called a pāṇi śankha (hand held conch) and the other is a jala śankha (water conch). The pāni śankha is generally an unmodified natural shell that has been carefully washed to remove the smell of the rotten mollusc. These are used in rituals for pouring holy water or simply for placing on the alter. A jala śankha is generally made by completely hollowing out the shell. This process is extremely time consuming because of the massive columella and the strong septa, but if it is done carefully, the final product is exquisite. Most jala śankha are incised with simple floral and geometric motifs and polished with the same acid solution used for bangles. Ritually, however, they are no different then simple unmodified shells.

As was mentioned above, the same workshops that produce objects for regional use by Hindu and tribal groups, also produce specific types of objects for trade to Bhutan, Tibet and Nagaland. Some of these objects are distributed even further abroad by indirect exchange, and shell objects made in Calcutta or Dhaka have been reported as far away as Burma, Northern Tibet and Eastern China. The initial movment of these goods is through Sankharis (sometimes other traders too) who come to Calcutta specifically to order these types of objects. In Assam and other peripheral

regions of Bengal , many Śankharis have set up shops to cater to Bengali populations or tribal groups. No primary manufacturing is carried out in these distant regions, probably because it is too difficult to acquire raw materials and tools. Consequently, these middlemen collect the whole range of shell objects from the workshops in Calcutta or Dhaka. Finished objects that cannot be produced in the distant workhops are purchased along with bangle blanks that will be processed with designs according to local demand. Whole shells and manufacturing wasters such as columella fragments and rough discs are also purchased. These rough pieces are usually sold to Naga tribals who grind and perforate them to make beads and pendants. In this system of distribution, specific types of manufacturing waste, such as columella and sawn body whorl fragments are carried to regions where no primary manufacturing is carried out. Waste products originating from the workshops in Calcutta go through one or more intermediary exchanges before being finally processed. Whole shells are also traded through this system, though not for manufacture. In Nagaland the shell was used as currency up until the 18th century; a cow being worth 10 conch shells and a male slave 13 conch shells (Hornell,1914:166).

Archaeological Significance.

The main objective of this ethnographic study has been to better understand variations in production and the types

of shell artifacts that would be found in possible archaeological contexts. In Calcutta, we see the greatest variety of shell artifacts because the workshops are run by different regional groups and many finished objects are brought to the city from regional workshops, for the larger urban market. A wider variety of raw materials are also found in the city because it is a major regional port of entry. In Barrackpore, which is just outside of Calcutta, the quantity of production is similar, but the variety of styles and artifact types are characteristic of those produced by East Bengali craftsmen. Further inland at Bishnupur, the quantity of raw materials and production is comparable to that seen in Barrackpore, but again, the style of ornaments shows characteristic regional styles. At the distant rural manufacturing center of Hatgram, production is on a smaller scale than at the other centers and the primary raw materials are recycled manufacturing waste. Some ornaments are produced in the regional styles of West Bengal, but other types reflect the specific demands of the rural and tribal markets.

There are many rural areas throughout Bengal where no shell manufacturing occurs, yet shell bangles and even unfinished bangles reach these areas through the movements of itinerant tradesmen/craftsmen. Further away, in peripheral regions there is a limited distribution of all major artifact types, including whole shells and primary sawing waste. Some of these pieces are carried to remote

areas that have no direct contact with the larger urban centers where the shell artifacts originated.

Theoretically it would not be difficult to differentiate all of these various occurances of shell objects and manufacturing waste. Careful excavations and sampling techniques would provide comparative data for defining each type of manufacturing center. On the basis of tiny chips and specific types of waste, it would be possible to determine if a site was engaged in the preliminary processing or secondary manufacture of bangles, etc. A sawn columella in a remote Naga village or a rough disc in Bhutan, could not be taken to indicate the presence of a shell industry because there would be no accompanying wasters from the other stages of manufacture. Similarly, an unfinished bangle in an isolated village would not indicate the presence of a cottage industry, but more likely the activity of itinerant traders. By using these general models, and comparing specific aspects of manufacturing waste and finished objects, it will be possible to make more reliable interpretations of the archaeological occurance of shell in different Indus sites.

Socio-Religious Aspects.

The primary reason for the continued existence of the shell industry in Bengal is the ritual importance of shell objects in every day life. Shell trumpets and libations vessels are still being used in temples and shrines throughout the Sub-Continent, but these prescribed ritual

uses have not been sufficient to support the production of these objects. Numerous minor traditions relating to the ritual use of shell still exist among isolated coastal communities, but it is only in Bengal that these traditions have been strong enough to sustain the production and use of shell ornaments , particularly bangles. This situation provides a unique glimpse of what apparantly was a more widespread custom during the Early Historic and Medieval Periods. The use of conch bangles in Bengal is quite varied in that the tribal women (Santhal and Bhil) wear them for their protective qualities, and they can be worn by unmarried women. Hindu women, however, only wear these bangles after they are married. This ritual is not prescribed in the major religious texts, nor is the officiating Brahmin involved in the ceremony when the bangles are placed on the bride's wrists. It is an older woman, one whose husband is still living and who has borne many children, who places these on the bride's wrists with blessings for a long happy marriage and many healthy children. Usually the shell bangles used in this ceremony are covered with red lac, but invariably a thin line of the white shell is exposed on one side. The ceremony itself takes place after the bride has been bathed, on the morning of the wedding. Many different reasons are given for wearing these bangles, but the main ones are to ensure a long life for one's husband (= long marriage) and many children (= fertility). If her husband dies, these bangles

are broken and thrown into the river or the village tank, and if they are accidently broken before his natural death, it is considered very inauspicious. Consequently, as soon as the wedding is over, the actual wedding bangles are usually placed in a safe box and a different pair of bangles is worn for everyday use. These bangles are worn for the same reasons and a faithful wife should always wear them, but since they are not the original wedding bangles, there is less trauma if they are broken.

There are numerous legends and later texts that substantiate the antiquity of this use of shell bangles with the wedding ritual. A common story that is heard in Bengal as well as in South India, relates how Siva commissioned the architect Visvakarma to create an exquisite new ornament for his consort Durga. After much searching, the conch shell "jewel" was found in the sea, and after further experimentation with the consultation of Agastya Muni, he made a saw to cut the shell. Finally, he was able to present a set of beautiful, dazzling white bangles to the Goddess and wearing them, she out shone all the other deities (Local Informants; Thurston, 1909,Vol.I;137). Another Tamil legend relates how Krishna managed to marry Rukmini by carrying her off and placing conch shell bangles on her wrists (Thurston,1909,Vol.II:354).

The similar use of ivory bangles in traditional marriages in Gujarat and Rajasthan, suggests that their ritual significance may have been adopted from an earlier

custom using shell.

The ritual importance of shell ornaments is not limited to women, and men often wear a simple conch shell finger ring or tie an amulet of shell around their arm. Even children are adorned with shell amulets, and if someone is sick, food and medicine are administered with shell ladles or the ritual jala śankha. The common belief in both the lesser and the greater traditions center on the protective and purifying nature of the white shell. Although other shells can be attributed with these same qualities, it is the *Turbinella pyrum* that has the highest place. Bangles worn by poor rural women may be made of broken pieces joined together with cheap lac, while wealthy women have their bangles wrapped in gold wire, but both serve the same purpose. Similarly, well endowed temples may use elaborately carved trumpets and libation vessels, but the ritual can still be carried out at household shrines using an undecorated or unmodified shell. Because of the fact that shell objects are available to almost anyone, and are worn and used by both men and women, we see their occurence in all domestic and non-domestic contexts. If a bangle is broken, it is usually buried near the local tank or at the foot of the holy tulsi bush in the courtyard. A broken ring is generally discarded anywhere and through one process or another shell objects become distributed throughout a village or city. Perhaps it is this pattern itself that can provide a model for better understanding the socio-ritual importance of shell in the Indus Civlization.

FIGURE 4-1. BENGAL; BANGLE MANUFACTURE WITH _Turbinella pyrum_.

1. Chipping the apex, _nal khola_.*
2. Sawing the anterior, _bor khola_.*
3. Sharpening the saw.
4. Sawing bangle blanks, _rekh kata_.*
5. Grinding, interior of bangle.*
6. Grinding, exterior of bangle.*
7. Incising.*
8. polishing with acid.*

* Adapted from Sen and Sinha, 1961.

FIGURE 4-1. BENGAL; BANGLE MANUFACTURE WITH Turbinella pyrum.

1

2

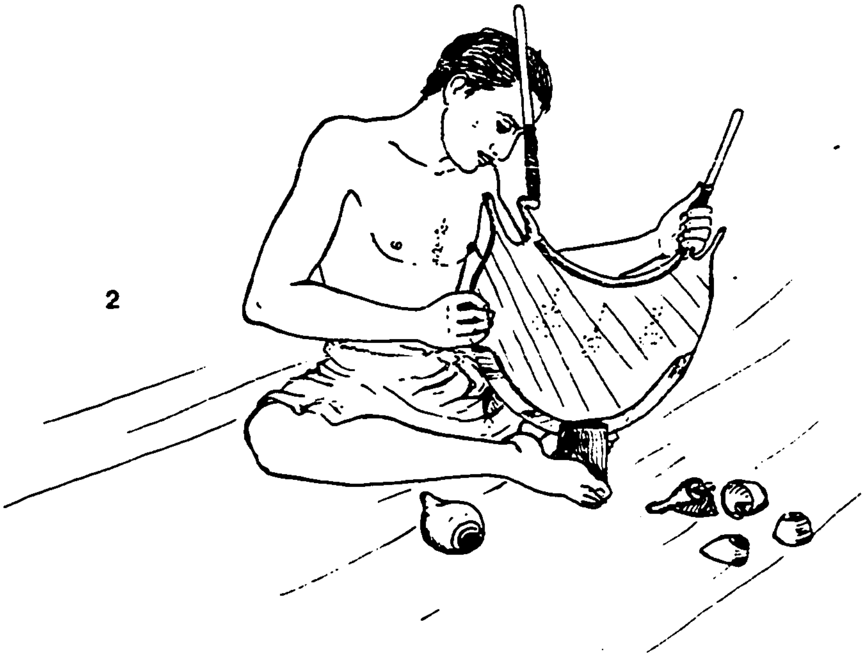
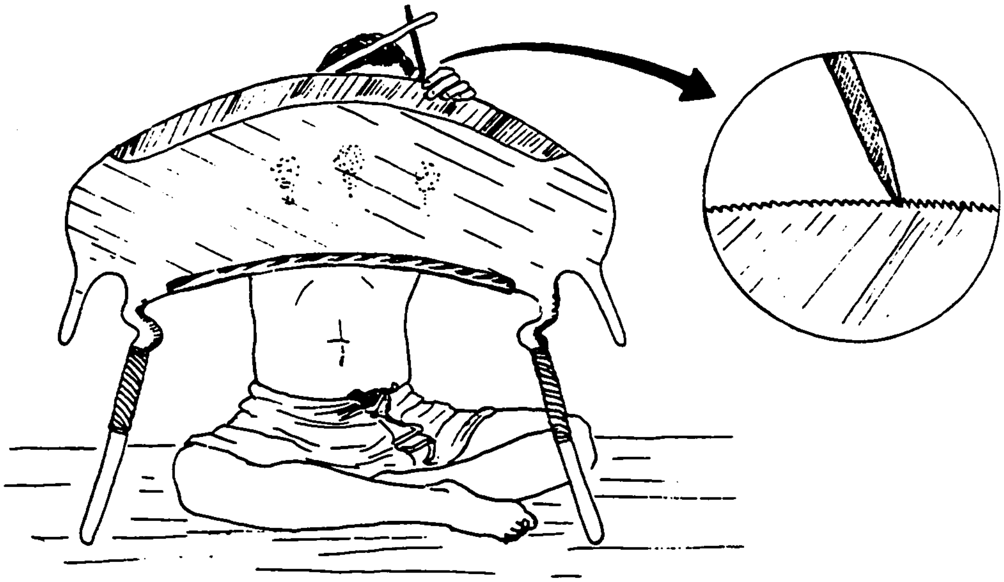


FIGURE 4-1. BENGAL; BANGLE MANUFACTURE WITH _Turbinella_ _pyrum_.



3

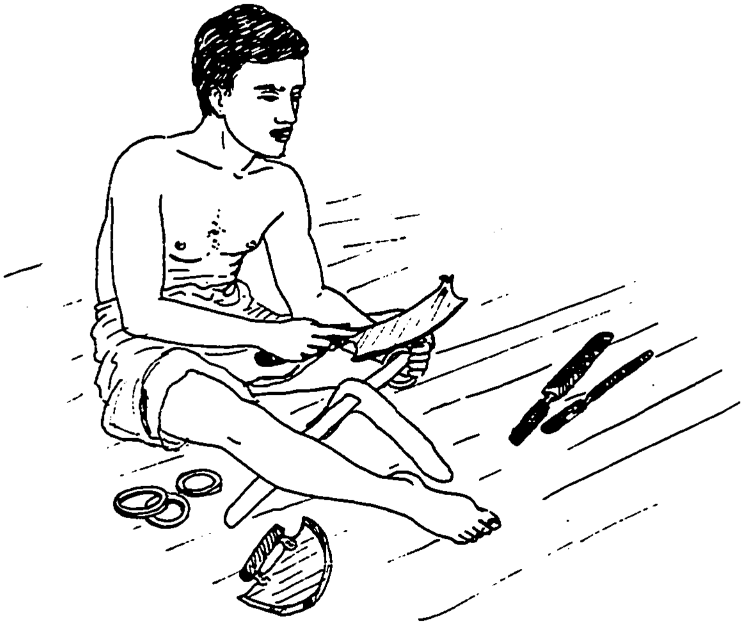
4

FIGURE 4-1. BENGAL; BANGLE MANUFACTURE WITH <u>Turbinella</u> <u>pyrum</u>.

5

6

FIGURE 4-1. BENGAL; BANGLE MANUFACTURE WITH Turbinella pyrum.



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CHAPTER V. SUMMARY AND CONCLUSION

The Indus Civilization has long been the object of theoretical discussions relating to its economic systems, internal trade, external trade, social stratification and religious systems. In this study I have approached some of these same questions through a detailed analysis of primary data from the major excavated sites, both rural and urban. Shell artifacts from these sites have formed the basis of my study and though in the past, the shell industry was considered relatively insignificant, it is now evident that it can provide important new perspectives on the socio-economic and socio-religious systems of the Indus Civilization.

Shell Collection.

By carefully studying the shell species used in this industry as a raw material, it has been possible to identify the major species used in the coastal and inland workshops. It is no longer necessary to refer to "conch shells" or simply the Arabian Sea when discussing the types of shells used in the industry or their source areas. By a critical recontruction of ancient coastlines and habitat areas, it has been possible to show the isolated distribution of some species, and identify three major source areas; the Gulf of Kutch, the Western coast near Ras Mauri, and the coast of

Oman. Through a detailed comparison of modern habitats and shell collecting techniques it is possible to develop new hypotheses regarding the exploitation of marine resources during the Indus Period. The collection of smaller molluscs can be done simply by walking along the beach, but the major gastropods collected for shell manufacturers reguired an intimate knowledge of the sea, both its resources and its dangers. Coastal communities on the Gulf of Kutch and along the Western Coast probably used similar collecting techniques as the water temperatures and visibility in both regions are quite similar. Turbinella pyrum was probably being collected at low tide by wading in the shallow bays or making shallow dives from boats. Occasionally this species can be found on reefs, and the presence of numerous wormed specimens at the major sites suggests that this method of collection was also being practiced. Chicoreus ramosus is found primarily in reef areas, and was undoubtedly being collected during low tide by wading or shallow dives. Although I have not been to the source areas for Lambis truncata sebae and Fasciolaria trapezium off the coast of Oman, it is probable that they too were being collected by wading or shallow dives since these species are reported from shallow sandy bottoms near the rocky islands just offshore. Along the Western coast, the large bivalve Tivela damaoides andother smaller species could have been collected from sandy beaches at low tide. The quantities of shell found at sites such as Balakot and Allahdino do not suggest

that shell collecting was done on a full-time basis by any one community, but was probably done as a supplement to other activities such as fishing. However, at Nageshwar, where intensive shell working was being carried out, it is conceivable that a group of divers-collectors may have been engaged at least part time in supplying the workshops with raw materials. Since all of these species are edible, it is not unlikely that their flesh formed an important part of the diet of these coastal communities. But, the low frequency of the large gastropods from Period I at Balakot and the predominance of bivalves and estuarine molluscs during Period II suggests that the collection of the larger species was primarily for their value as a raw material and not for consumption.

In view of the necessary specialization involved in marine explotation, these shell collectors and fishermen probably formed a distinct social group that came to be dependent on others for agricultural products and objects requiring specialized production, i.e. pottery, metal, cloth, etc.

Distribution of Raw Materials and Finished Products.

The internal trade/exchange systems that were used to distribute raw shells to distant inland sites were undoubtedly quite complex, and by looking only at shell artifacts it is not possible to make conclusive statements on their structure. Nevertheless, on the basis of the models seen in modern Bengal, we can suggest that the

acquisition/distribution of raw materials is closely related to the production and distribution of finished objects. Coastal sites, such as Balakot and Nageshwar, obviously had direct access to the raw materials, and it is not unlikely that the shell collectors and the shell workers were closely related socially. However, specialization in production would result in a sharp distinction between the two groups. At Balakot, the presence of two radically different methods of production suggests that perhaps some individuals did not have access to saws, or the skill to manipulate them. Distribution of raw materials and finished goods from the coastal sites to the inland manufacturing centers was probably defined by social ties between the major shell working communities. The existence of such social connections would explain the uniform technology used in shell productions and the standard types of designs. In the larger urban centers, the distinction between shell collectors and shell workers would have been even more pronounced, and possibly certain individuals or families were more involved in trade than production. The evidence for internal trade between coastal and inland sites suggests that there were several overlapping systems at work. First we can suggest the presence of direct contact trade between the inland urban centers and their regional source areas. Lothal would have been able to get shells from the Gulf of Kutch and urban sites in the Lower Sindhu/Nara plain could have gotten _T.pyrum_ from the Western coast. Other evidence,

of trade between the two coastal regions could be interpreted by two models, direct trade or central place trade. Chicoreus ramosus shell ladles at Balakot, Amri, Chanhudaro, etc. could have been brought directly from the Gulf of Kutch, or through an intermediate central place such as Mohenjo Daro, or even Lothal. The presence of a Tivela bangle at Lothal suggests that direct or indirect contacts existed along the coastal sea board, independent of the interior urban centers. Nevertheless, the evidence of strong contacts between Chanhu Daro and the Gulf of Kutch and its production at Mohenjo Daro could mean that many of the shell ladles in the central region were being distributed or manufactured at these important sites.

Mohenjo Daro, on the other hand, was engaged in a very different system of exchange and production. Raw materials used at the site were coming from all three major source areas. Individuals or families who controlled the production of shell objects appear to have had almost exclusive access to raw materials coming from the external source area. This could have been accomplished through their own direct trade contacts or the trade of other more important commodities such as copper. The isolated occurance of Lambis truncata sebae or Fasciolaria trapezium at some of the urban centers in the Lower Sindhu/Nara plain could be explained by the close social contacts between these various workshops. But, the fact that they were not in common use at these other sites indicates an important

qualitative stratification between the consumers at Mohenjo Daro and those of the smaller urban centers. Mohenjo Daro was undoubtedly a central place, which acquired raw materials from a wide variety of sources, processed them at the site or passed them on to other manufacturing centers. The most convincing evidence for this role is seen in the comparison of Mohenjo Daro with Harappa. The low frequency of shell artifacts and the lower variety of shell species at Harappa indicates that the raw materials were being transshipped through some intermediary site. Mohenjo Daro is the largest excavated site between Harappa and the sea, but other sites such as Ganweriwala may also have been instrumental in regulating the movement of marine products to Northern sites. In comparing Mohenjo Daro to other regional sites and the major urban center of Harappa, we can refer to the role of Calcutta with regard to Barackpur and Bishnupur.

Most of the sites discussed in this dissertation were involved in the production of shell objects, but as was noted in the previous chapter, several different levels of production can be seen. At each site, I have tried to determine the presence or absence of indicators relating to these different types of production. Some sites such as Kot Diji, Allahdino and possibly Amri, do not provide any convincing evidence for primary production. The presence of a few shell wasters could be attributed to the distribution of wasters from the larger manufacturing centers as was seen

in Bengal at the site of Hatgram. Similarly, the occurance of unfinished ladles at Balakot could indicate the secondary manufacture of materials already partly processed at other manufacturing centers. This distribution could be the result of direct contact with the production center, or through the medium of itinerant trader/craftsmen. It is not unlikely that many of the smaller rural sites were being supplied by this combined method of production and exchange. Finally, looking at the distribution of shell artifacts in peripheral regions, we find no evidence for any type of production. Admittedly, these regions have not been extensively explored and further evidence may result in the discovery of manufacturing wasters, but a few wasters does not demonstrate local production unless they are associated with other diagnostic indicators, such as tiny chips, unfinished pieces, etc. In studying the occurance of shell at peripheral sites , the model of distribution between Calcutta, Assam and remote tribal villages may be useful.

External Exchange.

The main emphasis of this study has been on the distribution of shell within the Indus Civilization, but it would be wrong not to briefly discuss the long distance trade/exchange of shell objects. Trade contacts between the Indus Civilization and Mesopotamia have been a controversial topic ever since the sites of Mohenjo Daro and Harappa were first excavated, but finally, researches in the intervening Gulf regions have reliably demonstrated the presence of sea

trade between these two regions (see Ratnagar 1981 for full discussion and bibliography). Whether or not this trade was through direct contact, i.e. traders from one region travelling to the other, or though the activities of middlemen, is still undecided. Nevertheless, objects from one region were reaching the other, and Mesopotamian texts give long lists of objects that most probably originated in the lands of the Indus Civilization. Shell has rarely been identified as an important trade item, primarily because many of the species identified at Mesopotamian sites occur commonly in the Gulf region. Hornell was one of the first to note that some of the Mesopotamian shell artifacts were made from Turbinella pyrum, a species whose nearest major source is near Ras Mauri (Hornell,1941). Unfortunately, Hornell never published any references to these unique objects except to say that they were from the sites of Ur, Kish, and Lagash. In studying the available excavation reports, I have not been able to identify any shell objects from these sites that can definitely be attributed to this species. However, in the course of my studies I have noted shell cylinder seals from Tepe Gawra (University Museum, Penn.) and Susa (National Museum of Art and History, Brussels) that have been made from the massive columella of a gastropod, which I would tentatively identify as Turbinella pyrum. Further clues are found at Susa (provenience not known), where a wide shell bangle incised with the traditional Indus period chevron design has been

reported (Tosi *et al.*,1981: fig.13). The artifact is in the Louvre, and Durante has identified this shell as being from *Fasciolaria trapezium*, but on the basis of what can be seen in the photograph I would identifiy the shell as being *Turbinella pyrum*. Several shell discs have also been published (*Ibid*.:Fig.18), which can also be tentatively identified as being made from *T.pyrum*. Identical discs are quite common at all of the major Indus period sites. If these few example are any indication of the types of artifacts and species common at Mesopotamian sites, and if Hornell was correct in his identification of *T.pyrum* at Ur, Kish and Lagash, then the whole question of Indus/Mesopotamia trade contacts must be reexamined.

A beginning would be the critical analysis of the textual evidence. Mesopotamian texts often refer to the import of ivory and ivory objects from Dilmun, Maggan and Meluhha (Oppenheim,1954). However, ivory was not common at Mesopotamian sites and as Possehl has pointed out, no ivory objects have been reported from the important site of Ur (Possehl,1979:162-63). Possibly the Mesopotamians were mistaking shell inlay for ivory (or being cheated), or perhaps they used the same word for both materials. Shell inlay is common on temple furniture , as frames around carved stone plaques (Frankfort,1932:45-46) and numerous shell objects have been recovered from palaces and royal tombs (Mackay,1929). If some of these shell objects were being imported from the Indus workshops, then how does

their role in ritual and elite contexts in Mesopotamia relate to their role in the Indus Civilization?

Socio-Religious Aspects.

Having carfully examined the various contexts in which shell objects occur in the Indus Civilization, we can only point out that it does not occur in any specific ritual or luxury context. No temples have been identified nor have any palaces, and shell artifacts are quite as plentiful in the lower habitational sectors as in the so called "citadel" areas. At Mohenjo Daro the apparent paucity of shell bangles from "L Area" excavations must remain unexplained until further surface studies and artifact comparisons can be made. In burials, the irregular occurance of shell objects, particularly bangles, does not suggest that they played an important role as funerary offerings. In direct contrast to Mesopotamian occurances, shell objects are found in almost all parts of the sites. Many of the Indus sites were producing shell artifacts, and wasters are found scattered over large areas of a site. Some wasters were being reused in other industries, such as the backing for bow drills or pottery scrapers. A wide range of finsihed objects were being produced that undoubtedly had numerous different functions; technological (i.e. shell measuring stick), ornamental, utilitarian and possibly ritual. On the basis of many terra cotta and especially the famous copper/bronze figurine of the "dancing girl" it is evident

that bangles were worn commonly worn by women, nonetheless, occasionall ornamented male figurines and particularly the representation of numerous bangles on both arms of the famous "proto-Śiva" seal from Mohenjo Daro indicate that they may also have been worn by men. The widespread use of bangles at all Mature Indus sites, even as far away as Shortugai, indicates that they were important ornaments, either for social reasons or for ritual purposes. Similarly, shell ladles are present at almost all Indus sites and yet they must have been very valuable because of the time involved in production and the distant source area. Although many shell objects are quite simple, the manufacture of exquisite carved figurines, ornamental ladles, and the carfully hollowed out and incised shell vessels suggest that some one or some group wanted more elaborate objects made. One interpretation could be that these exquisite objects were used as indicators of wealth or status symbols, but since they have all been found in general habitation contexts it is difficult to determine who could have been using them. I have not been able to make a detailed study of the other types of artifacts that may have been associated with these objects, and it will be interesting to see if similar patterns can be discerned in other types of artifacts, such as stone beads or stoneware bangles.

In view of the continuity of shell working traditions from the Mature Indus period to the Early Historic period in

Kathiawar, it can be suggested that the some of the socio-ritual uses of shell in the later period may have had their roots in the Indus Civilization. By this I do not mean that there is any direct relationship with specific Hindu or Buddhist traditions, but rather that there was a continuity in the abstract concept relating to the protective and purifying quality of the white shell. This concept is undoubtedly much older than the Hindu traditions and yet it pervades the use of shell in all of its various forms. Perhaps it is even older than the Indus Civilization, since we see the beginnings of shell working as early as the Neolithic period, in Mehrgarh.

Through a careful study of the numerous aspects of the shell industry it has been possible to present concrete data relating to important technological developments of shell working and copper/bronze technology. Differential access to marine resource areas and distribution of specific shell species at inland sites has demonstrated the complexity of the internal trade and exchange networks connecting each region. The ethno-archaeological study of modern shell working in Bengal has shown how we can develop important new models for interpreting the archaeological evidence. Shell artifacts can provide a vast amount of information, and in this study I have only been able to deal with a few facets of this data. Many other types of artifacts have the same potential, and though in the past, stone bead manufacturing, steatite seal carving, faience production etc. have

received some attention, much remains to been done. It is only through a detailed study of these lesser industries, that we will begin to understand the development of socio-economic systems in the Indus Civilization.

ABBREVIATIONS

APAMNH	Anthropology Papers of the American Museum of Natural History, New York
BDCRI	Bulletin of the Deccan College Research Institute, Poona.
IAR	Indian Archaeology-Review, Archaeological Survey of India, New Delhi.
JAOS	Journal of the American Oriental Society, New York, New Haven/Baltimore.
MASI	Memoirs of the Archaeological Survey of India, New Delhi.
SAA:1971	South Asian Archaeology:(1971), Normand Hammond ed. London: Duckworth.
SAA:1973	South Asian Archaeology:1973, J.E. van Lohuizen-de Leeuw and J.J.M.Ubaghs eds.1975, Leiden:E.J. Brill.
SAA:1975	South Asian Archaeology:1975, Paris:
SAA:1977	South Asian Archaeology:1977, 2 Vols., M.Taddei ed.,1979. Naples: Ist.Univ.Orientale Seminario di Studi Asiatici.
SAA:1979	South Asian Archaeology:1979, H.Hartel ed. 1981, Berlin: Reimer.

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APPENDIX I: MARINE MOLLUSCA FOUND AT INDUS PERIOD SITES

The following list includes all major Families found in the Arabian Sea, from the coasts of Kathiawar to the Gulf of Oman and into the Arabian/Persian Gulf. Some Families are not represented yet in th archaeological record and therefore no species are listed. All species listed below have been identified or closely resemble molluscs found at Indus sites. Species found at each different site are listed in Appendix III. It has not been possible to illustrate all of the different species, but adequate illustrations are available in the references cited below each species.

CLASS GASTROPODA

SUPER FAMILY FISSURELLACEA = PLEUROTOMARIACEA
FAMILY FISSURELLIDAE
SUPER FAMILY PATELLACEA
FAMILY PATELLIDAE

Species: *Cellana karachiensis* Winkworth,1930
(Smythe,1982:36,Pl.1b)

FAMILY ACMAEDAE

Species: *Acmaea profunda* Deshayes,1863

SUPER FAMILY TROCHACEA
FAMILY TROCHIDAE

Species: *Trochus radiatus* (Gmelin,1791)
(Kaicher,1956,Sec.4:Pl.2-16)
Species: *Umbonium vestiarium* (Linnaeus,1758)
(Smythe,1982:39,Pl.10a)

FAMILY STOMATELLIDAE

FAMILY TURBINIDAE

Species: *Turbo coronatus* (Gmelin,1791)
(Kaicher,1956,Sec.4:Pl.4-4)
Species: *Turbo radiatus* (Gmelin,1791)

(Smythe,1982:42,Pl.9e)
FAMILY PHASIANELLIDAE

SUPER FAMILY NERITACEA
FAMILY NERITIDAE

Species: Nerita albicilla Linnaeus,1758
(Smythe,1982:42,Pl.1d)
Species: Neritina polita Linnaeus,1758

FAMILY PHENACOLEPADIDAE

SUPER FAMILY LITTORINACEA
FAMILY LITTORINIDAE

Species: Littorina (Littoraria) coccinea (Gmelin,1791)
Synonomy: Littorina obesa Sowerby,1839
(Kaicher,1956,Sec.3:Pl.1-5)

Species: Littorina scabra (Linnaeus,1758)
Synonomy: Melarphe scabra Linnaeus,1758
(Smythe,1982:43,Pl.9f)

FAMILY RISSOINIDAE

SUPER FAMILY ARCHITECTONICAEA
FAMILY ARCHITECTONICIDAE

SUPER FAMILY CERITHIACEA
FAMILY TURRITELLIDAE

Species: Turritella bacillus Kiener,1843
(Kaicher,1956,Sec.2:Pl.1-5)
Species: Turritella torulosa Kiener,1843
(Smythe,1982:45,Pl.2c)

FAMILY VERMETIDAE

Species: Vermetus sulcatus Lamarck,1818
(Smythe,1982:43,Pl.9f)
FAMILY PLANAXIDAE

Species: Planaxis sulcatus (Born,1778)
(Kaicher,1956,Sec.3:Pl.2-7)

FAMILY MODULIDAE
FAMILY POTAMIDAE

Species: Telescopium telescopium (Linnaeus,1758)
(Kaicher,1956,Sec.3:Pl.2-14)

Species: Terebralia palustris (Linnaeus,1758)
(Kaicher,1956,Sec.3:Pl.2-15)

FAMILY CERITHIIDAE

Species: Cerithium (Clypeomorus) morus Lamarck,1799
(Kaicher,1956,Sec.3:Pl.3-8)
Species: Cerithium bifasciatum Sowerby,1855
(Smythe,1982:47,Pl.10d)

FAMILY CERITHIOPSIDAE
FAMILY TRIPHORIDAE
SUPER FAMILY EPITONIACEA
FAMILY EPITONIIDAE
FAMILY JANTHINIDAE
SUPER FAMILY EULIMACEA
FAMILY MELANELLIDAE
SUPER FAMILY HIPPONICACEA
FAMILY VANIKORIDAE

Species: Vanikoro sulcata d'Orbignyi,1842
(Smythe,1982:51,Pl.1g)

SUPER FAMILY CALYPTRACEA
FAMILY CALYPTRAEIDAE
SUPER FAMILY STROMBOIDEA = STROMBACEA
FAMILY XENOPHORIDAE
FAMILY STROMBIDAE

Species: Tibia insulaechorab Roding,1798
Synonomy: Tibia insulaechorab curta (Sowerby,1842)
Tibia (Rostellaria) curvirostris (Lamarck,1799)
(Smythe,1982:53,Pl.12b)

Species: Terebellum terebellum (Linnaeus,1758)
Synonomy: Conus terebellum Linnaeus,1758
(Smythe,1982:53,Pl.2b)

Species: Lambis lambis (Linnaeus,1758)
Synonomy: Strombus lambis Linnaeus,1758

Species: Lambis truncata sebae (Kiener,1843)
Synonomy: Pterocera (Heptadactylus) sowerbyi Morch,1872

Species: Strombus cf. tricornis (Humphrey,1786)

SUPER FAMILY CYPRAEACEA
FAMILY CYPRAEIDAE

Species: Erosaria turdus (Lamarck,1810)
Synonomy: Cypraea turdus Lamarck,1810
(Kaicher,1956,Sec.2:Pl.3-18)
Species: Erosaria lamarcki (Gray,1843) ?
(Kaicher,1956,Sec.2:Pl.3-17)

Species: Erosaria ocellata (Linnaeus,1758)
(Kaicher,1956.Sec.2:Pl.3-20)
Species: Callistocypraea testudinaria Linnaeus,1758
(Kaicher,1956.Sec.2:Pl.5-3)
Species: Peribolus (Arabica) grayana (Schilder,)
Synonomy: Cypraea arabica Linnaeus,1758
Synonomy: Mauritia grayana Schilder,
(Kaicher,1956.Sec.2:pl.5-8)

FAMILY OVULIDAE
SUPER FAMILY NATICACEA
FAMILY NATICIDAE

Species: Polinices tumidus (Swainson,1840)
Synonomy: Polinices mamilla Linnaeus,1758
(Kaicher,1956,Sec.2:Pl.1-1)
Species: Neverita didyma (Roding,1798)
Synonomy: Polinices didyma Roding,1798
(Kaicher,1956.Sec.2:Pl.2-3)

Species: Natica lineata (Roding,1798)
Synonomy: Natica lineata Lamarck,1799
(Kaicher,1956,Sec.2:Pl.2-2)
Species: Natica tigrina (Roding,1798)
(Kaicher,1956,Sec.2:Pl.2-3)

SUPER FAMILY TONNACEA
FAMILY CASSIDIDAE
FAMILY CYMATIIDAE

Species: Cymatium lotorium Linnaeus,1758
(Kaicher,1956,Sec.1:Pl.2-10)

FAMILY BURSIDAE

Species: Bursa bardeyi Jousseaume,1894

FAMILY FICIDAE

Species: Ficus variegata Roding,1798
Species: Ficus subintermedia (d'Orbigny,1852)
(Identified by A. Solem from Allahadino)

FAMILY TONNIDAE

Species: Tonna olearium Linnaeus,1758
(Kaicher,1956.Sec.1:Pl.5-7)

SUPER FAMILY MURICACEA
FAMILY MURICIDAE

Species: Chicoreus (Chicoreus) ramosus (Linnaeus,1758)
Synonomy: Murex ramosus Linnaeus,1758
Synonomy: Murex inflatus Lamarck,1799 ?

Species: *Chicoreus brunneus* Link,1807
Species: *Murex scolopax* Dillwyn,1817

FAMILY THAIDIDAE

Species: *Thais mutabilis* (Link,1807)
Synonomy: *Thais carinifera* Lamarck,1799
(Smythe,1982:61,Pl.3d)
Species: *Thais rugosa* Born,1778
(Kaicher,1957,Sec.7:Pl.5-7)
Species: *Cronia konkanensis* (Melvill,1893)
(Smythe,1982:60,Pl.1i)

SUPER FAMILY BUCCINACEA
FAMILY BUCCINIDAE

Species: *Babylonia spirata* Lamarck,1799
(Kaicher,1957,Sec:Pl.6-20)

Species: *Engina mendicaria* Linnaeus,1758
(Kaicher,1957,Sec7:Pl.6-8)
Species: *Engina* species not determinable.

FAMILY PYRENIDAE

Species: *Pyrene espersa* (sic. Durante,1977)
Species: *Perene cf. flava* Bruguiere,1789

FAMILY GALEOIDAE

Species: *Pugilina buchephala* (Lamarck,1799)
Synonomy: *Melongena bucephala* (Lamarck,1799)
Synonomy: *Pugilina pugilina* Born,1822
Synonomy: *Pugilia carnarius* Röding,1798 ?
(Kaicher,1957,Sec.7:Pl.7-7)

FAMILY COLUMBELLIDAE
FAMILY NASSARIIDAE
FAMILY FASCIOLARIIDAE

Species: *Fasciolaria trapezium* Linnaeus,1758
(Kaicher,1957,Sec.7:Pl.8-12)

SUPER FAMILY VOLUTACEA
FAMILY TURBINELLIDAE = VASIDAE

Species: *Turbinella pyrum* (Linnaeus,1767)
Synonomy: *Xancus pyrum* (Linnaeus,1767)

FAMILY OLIVIDAE

Species: *Oliva bulbosa* Röding,1798
(Smythe,1982:65,Pl.3a)

FAMILY	MITRIDAE
FAMILY	CANCELLARIIDAE
FAMILY	MARGINELLIDAE
SUPER FAMILY	TOXOGLOSSA
FAMILY	TEREBRIDAE
FAMILY	TURRIDAE

Species: *Lophiotoma acuta* (Perry, 1811)
Synonomy: *Lophiotoma tigrina* Lamarck, 1799 ?

FAMILY CONIDAE

Species: *Stephanoconus ebraeus* (Linnaeus, 1758)
(Kaicher, 1956, Sec. 5: Pl. 2-9)
Species: *Chelyconus betulinus* (Linnaeus, 1758)
(Kaicher, 1956, Sec. 5: Pl. 6-8)
Species: *Lithoconus quercinus* Solander, 1786
(Kaicher, 1956, Sec. 5: Pl. 5-9)
Species: *Conus tessulatus* Born, 1778
(Kaicher, 1956, Sec. 5: Pl. 5-11)

SUPER FAMILY	ONCHIDIACEA
FAMILY	ONCHIDIIDAE
FAMILY	ACTEONIDAE
FAMILY	RINGICULIDAE
FAMILY	HYDATINIDAE
FAMILY	BULLIDAE
FAMILY	RETUSIDAE
FAMILY	CYCLICHNIDAE
FAMILY	ATYDIDAE
SUPER FAMILY	MELAMPIDACEA
FAMILY	ELLOBIIDAE
SUPER FAMILY	AMPHIPOLACEA
FAMILY	SIPHONARIIDAE

CLASS SCAPHOPODA

SUPER FAMILY	DENTALIIACEA
FAMILY	DENTALIIDAE

Species: *Dentalium octangulatum* Donovan, 1803
Species: *Dentalium variabile* (sic. Durante)

CLASS PELECYPODA

SUPER FAMILY ARCACEA
FAMILY GLYCYMERIDIDAE
FAMILY ARCIDAE

Species: Anadara granosa (Linnaeus,1758)
Synonomy: Arca granosa Linnaeus,1758

Species: Anadara antiquata (Linnaeus,1758)

Species: Anadara deyrollei (sic. Durante)

Species: Scapharca inaequivalvis (Bruguiere,1789)
(Khan and Dastagir,1972:2,Pl.1,2a)
Species: Scapharca disparilis Reeve,1844

FAMILY CUCULLAEIDAE
SUPER FAMILY PTERIACEA
FAMILY ISOGNOMONIDAE

Species: Isognomen legumen (Gmelin,1791)
(Smythe,1982:88,Pl.6f)

FAMILY MALLEIDAE
FAMILY PTERIIDAE

Species: Pinctada radiata (Leach,1814)
Synonomy: Pinctada vulgaris (Schumacher,)
(Khan and Dastagir,1972:7,Pl.4,13)
Species: Pinctada margaritifera (Linnaeus,1758)
(Smythe,1982:88,Pl.6c)

SUPER FAMILY MYTILACEA
FAMILY MYTILIDAE
FAMILY PINNIDAE

Species: Pinna muricata Linnaeus,1758
(Smythe,1982:91,Pl.8)

FAMILY PECTINIDAE

Species: Chlamys townsendi (Sowerby,1895)

FAMILY PLICATULIDAE

Species: Plicatula imbricata Menie,1843

FAMILY SPONDYLIDAE

Species: Spondylus exilis Sowerby,1895
Synonomy: Spondylus gaederopus (Linnaeus,1758)
(Khan and Dastagir,1972:10,Pl.6,18)

(Smythe,1982:93,Pl.14b)

FAMILY	LIMIDAE
SUPER FAMILY	ANOMIACEA
FAMILY	ANOMIIDAE

Species: Placuna placenta (Linnaeus,1758)
Synonomy: Anomia placenta Linnaeus,1758

Species: Anomia laqeata Reeve,1859

FAMILY	PLACUNIDAE
FAMILY	OSTREIDAE

Species: Cassostrea madrasensis (Preston,)
Species: Saccostrea culcullata (Born,1775)
Synonomy: Ostrea cucullata Born,1775
(Smythe,1982:96,Pl.7f)

SUPER FAMILY	CARDITACEA
FAMILY	CARDITIDAE

Species: Cardita bicolor (Lamarck,1799)
(Khan and Dastagir,1972:17,Pl.11,35a)

SUPER FAMILY	ARCTICACEA
FAMILY	TRAPEZIIDAE
SUPER FAMILY	LUCINACEA
FAMILY	LUCINIDAE

Species: Codakia tigrina (Linnaeus,1758)
(Khan and Dastagrir,1972:19,Pl.11,35a)

FAMILY	UNGULINIDAE
SUPER FAMILY	CHAMACEA
FAMILY	CHAMIDAE
SUPER FAMILY	CARDIACEA
FAMILY	CARDIIDAE

Species: Cardium assimile Reeve,1845
(Khan and Dastagir,1972:21,Pl.12,40)
Species: Trachycardium lacunosum (Reeve,1845)
(Smythe,1982:100,Pl.18c)

SUPER FAMILY	VENERACEA
FAMILY	VENERIDAE

Species: Tivela damaoides (Gray,1843)
(Smythe,1982:105,Pl.18e)
Species: Tivela polita (Sowerby,1851)
Species: Meretrix meretrix (Linnaeus,1758)
Species: Meretrix casta Chemnitz sic. Romer,1896:31
Species: Meretrix ovum Hanley, sic. Romer,1896:38
Species: Callista impar Lamarck,1799
Species: Callista umbonella Lamarck,1799

Species: *Dosinia ceylonica* Dunker,1858
Species: *Dosinia cretacea* Reeve,1845
(Khan and Dastagir,1972:28,Pl.17,57)

FAMILY PETRICOLIDAE
SUPER FAMILY MACTRACEA
FAMILY MACTRIDAE
FAMILY MESODESMATIIDAE

SUPER FAMILY TELLINACEA
FAMILY DONACIDAE
Species: *Donax townsendi* Sowerby,1851
(Khan and Dastagir,1972:32,Pl.18,64)

FAMILY PSAMMOBIIDAE

Species: *Gari* cf. *occidens* (Gmelin,1791)
(Smythe,1982:108,Pl.14e)
cf. *ruppelliana* (Reeve,1857)
(Smythe,1982:109,Pl.19b)

FAMILY SOLECURTIDAE
FAMILY SEMELIDAE
FAMILY TELLINIDAE
SUPER FAMILY SOLENACEA
FAMILY SOLENIDAE
SUPER FAMILY MYACEA
FAMILY CORBULIDAE
SUPER FAMILY GASTROCHAENACEA
FAMILY GASTROCHAENIDAE
SUPER FAMILY PHOLADACEA
FAMILY PHOLADIDAE
SUPER FAMILY PANDORACEA
FAMILY PANDORIDAE
FAMILY LATERNULIDAE
SUPER FAMILY CLAVAGELLACEA
FAMILY CLAVAGELLIDAE

APPENDIX II: RECORDING AND CLASSIFICATION OF SHELL ARTIFACTS.

One of the main shortcomings of shell artifact descriptions in the early excavation reports has been the lack of understanding which features of the artifact is most important. Although no excavator is expected to provide all of the necessary data regarding each type of artifact, certain basic aspects should be recorded. In the following section I have provided the coding system developed for recording the most significant features of the shell artifacts that I have encountered so far. Additional features can be added in the spaces provided for additional data. The codes that I have listed here are ones that I have developed, and are therefore subjective. In distinguishing each feature of the shell artifact(i.e. "condition") and defining the various possible states that can be encountered (i.e. 1) Fresh, 2) slightly decalcified, 3) heavily decalcified, 4) burnt.), I have tried to avoid confusing the definition by using overlapping or entirely unrelated states. However, some artifacts require more detailed recording then others, so one entry records the feature such of surface treatment, that is the nature of the surface (i.e. 1) unworked,2) partly ground,...7) incised, design fresh, etc.) , while another entry will record the specific types of incised designs. All of these systems are

based on an 80 column format using both Alph-numeric (A), and Integer (I) data types.

II:1. GENERAL RECORDING CODE FOR ALL SHELL ARTIFACT TYPES.

COLUMN	DATA/INFORMATION	TYPE	Code/Examples
1-2	SITE	A	AA= Amri, Mound A
			MD=Mohenjo Daro, etc.
3-4	YEAR	I	26= 1926
5-8	AREA	A	SD= SD Area
			VSNE= VS Area, Northeast
			MNS = Moneer Area, South
			etc.
9-13	NUMBER	I	Artifact #, 0 to 99,999
14-17	PROVENIENCE	A	Depending on Excavation
			1500= N/S Grid Coordinates
18-21	PROVENIENCE	A	256= E/W Grid Coordonates,
22-23	PROVENIENCE	A	additional coordinates
24-26	ARTIFACT TYPE	I	See Appendix II:3 for Code
27	CONDITION	I	1) Fresh/Not decalcified
			2) Slightly decalcified
			3) Heavily decalcified
			4) Burnt/Smoked
28	WORM HOLES	I	1)Present 2) Absent
29	EXTERIOR SURFACE	I	code same as 30
30	INTERIOR SURFACE	I	

1) Natural shell surface
2) Partly ground
3) Ground, with striae visible
4) Smooth, no deep striae visible
5) Smooth, rounded, high polish

6) Incised, design worn

7) Incised, design fresh

8) Incised, design very faint

9) Not Determinable (i.e. burnt or entirely decalcified.

10) Ground smooth, natural shell in hollows

11) Ground, but saw marks visible

12) Ground, Saw marks and natural shell

13) Sawn fragment, with natural shell

31-34	LENGTH	I	Maximum length: mm
35-38	WIDTH	I	Maximum width: mm
39-42	THICKNESS	I	Maximum thickness: mm
43-45	PERFORATION DIA.	I	Minimum/Maximum: mm
46-48	DEPTH OF SAW CUT	I	Maximum: mm
49-51	WIDTH OF SAW CUT	I	Minimuim: 1/10 mm
52-54	DEPTH,EACH SAW STROKE	I	Maximum: 1/10 mm
55-58	ADDITIONAL MEAS.	I	Additional
59-60	SPECIES	I	1) Turbinella pyrum

2) Chicoreus ramosus 3) Fasciolaria trapezium

4) Lambis truncata sebae 5) Pugilina buchephala

6) etc.

61	RELATIVE SIZE (of shell used to make make an artifact)	I	1) Medium 2) Large 3) Small 4) Not deter.
62	PORTION OF SHELL (from which an artifact has been made)	I	1) Apex 2) Spire 3) Body Whorl 4) Columella 5) Outer lip 6) Inner Septa

63	ADDITIONAL	I	Additional
64-65	CRAFT INDICATOR	A	1a) Ornament,Bead
			1b) Ornament,Pendant
			1c) Bangle
			1d) Ring

2a) Ornament manufact. waste — 2b)Bangle manufact. waste

3) Finished Ladles — 4) Ladle manufact. waste

5) Finished Inlay — 6) Inlay manufact. waste

7) Other Objects — 8) Other manufact. waste

66-80	COMMENTS	A	Optional

II:2. SPECIFIC RECORDING CODE FOR GASTROPOD BANGLE FRAGMENTS.

COLUMN	DATA/INFORMATION	TYPE	Code/Examples
1-2	SITE	A	AA= Amri, Mound A
			MD=Mohenjo Daro, etc.
3-4	YEAR	I	26= 1926
5-8	AREA	A	SD= SD Area
			VSNE= VS Area, Northeast
			MNS = Moneer Area, South
			etc.
9-13	NUMBER	I	Artifact #, 0 to 99,999
14-17	PROVENIENCE	A	Depending on Excavation
			1500= N/S Grid Coordinates
18-21	PROVENIENCE	A	256= E/W Grid Coordonates,
22-23	PROVENIENCE	A	additional coordinates
24-26	ARTIFACT TYPE	I	See Appendix II:3 for Code
27	CONDITION	I	1) Fresh/Not decalcified
			2) Slightly decalcified
			3) Heavily decalcified
			4) Burnt/Smoked
28	WORM HOLES	I	1)Present 2) Absent
29	EXTERIOR SURFACE	I	code same as 30
30	INTERIOR SURFACE	I	

1) Natural shell surface

2) Partly ground

3) Ground, with striae visible

4) Smooth, no deep striae visible

5) Smooth, rounded, high polish

6) Incised, design worn

7) Incised, design fresh

8) Incised, design very faint

9) Not Determinable (i.e. burnt or entirely decalcified.

10) Ground smooth, natural shell in hollows

11) Ground, but saw marks visible

12) Ground, Saw marks and natural shell

13) Sawn fragment, with natural shell

31-34	MEASURE 1	I	Minimum Internal Diameter: mm
35-38	MEASURE 2	I	Maximum Internal Diameter: mm
39-41	WIDTH	I	Maximum Width : millimeters
42-44	THICKNESS	I	Maximum Thickness: millimeters
45-46	SECTION	I	1) W>T rounded

2) W>T faceted	3) W<T rounded
4) W<T faceted	5) W>T flat
6) W<T flat	7) W>T 1 shallow groove
8) W>T 2 shallow grooves	9) W<T 1 groove
10) W<T 2 grooves	11) W<T 3 grooves
12) W>T 1 groove	13) W>T 2 grooves
14) W>T 3 grooves	15) W>T 4 grooves
16) W>T squared channel	17) W<T round section
18) W>T oval section	19) W>T bevelled section
20) W>T complex design	21) W<T complex design
22) W<T 4 grooves	23) W<T squared channel
24) W>T 3 shallow grooves	25) W>T 2 squared channels
26) etc.	

47-48	SUTURE	I	1) thin 2) thick
49-50	INCISED DESIGN	I	1) chevron
2) diagonal slash			3) chevron/slash
4) accentuated suture			5) suture line
6) perpendicular scratches			7) multiple sutures
8) accentuated multiple sutures			9) no incising
10) reversed chevron			11) chevron with script
51-52	LENGTH OF DESIGN	I	Maximum length of chevron: mm
53-55	ADDITIONAL FEATURES	I	Additional
56-58	ARTIFACT TYPE	I	See Code in Appendix II:3
59-60	SPECIES	I	1) Turbinella pyrum
2) Chicoreus ramosus			3) Fasciolaria trapezium
4) Lambis truncata sebae			5) Pugilina buchephala
6) etc.			
61-63	ADDITIONAL	I	Additional
64-65	CRAFT INDICATOR	I	1c) Finished Bangle
			2b) Bangle manufact. waste
66-80	COMMENTS	A	Optional

II:3 SHELL ARTIFACT TYPE CODES.

CRAFT INDICATOR	OLD CODE NUMBER	NEW CODE NUMBER	TYPE OF ARTIFACT
000	59.	1	Unworked Shell, complete.
000	90.	2	Unworked shell fragment or chip.
000	100.	3	Spalled shell fragment.
000	83.	4	Unperforated valve, Lamellidens marginalis.
001a	12.	5	Bead, cylinder disc.
001a	31.	6	Bead, short cylinder.
001a	30.	7	Bead, standard or long cylinder.
001a	32.	8	Bead, short circular oblate.
001a	36.	9	Bead, standard or long barrel.
001a	13.	10	Bead, plano-convex disc.
001a	14.	11	Bead, concave-convex disc.
001a	15.	12	Bead, concave-convex, with "v" perforation.
001a	33.	13	Bead, short truncated bicone.
001a	34.	14	Bead, standard or long truncated bicone.

001a	35.	15	Bead, standard or long elliptical.
001a	91.	16	Bead, tabular, quadrangular.
001a	92.	17	Bead, tabular, polygon.
001a	106.	18	Bead, other shapes.
001a	16.	19	Other perforated discs.
001b	88.	20	Bead/Pendant, perforated natural shell.
001c	89.	21	Bangle
001c	69.	22	Bangle, last sawn piece.
001d	54.	23	Ring.
002a	39.	24	Chipped and ground bead blank.
002a	93.	25	Partly drilled fragment.
002b	63.	26	Manufacturing waste, chipped outer lip.
002b	60.	27	Manufacturing waste, apex fragment.
002b	62.	28	Manufacturing waste, chipped columella.
002b	76.	29	Manufacturing waste, chipped inner septa.
002b	65.	30	Manufacturing waste, sawn anterior.
002b	66.	31	Manufacturing waste, chipped/sawn columella.
002b	64.	32	Manufacturing waste, sawn whorl fragment.

002b	61. 33	Manufacturing waste, sawn spire.
002b	105. 34	Sawn body whorl, Chicoreus ramosus.
003	1. 35	Ladle with handle
003	2. 36	Ladle fragment without handle.
003	3. 37	Shell bowl or cup, without handle.
003	82. 38	Incised ladle fragment, Chicoreus ramosus.
004	78. 39	Sawn outer lip/spines, C. ramosus.
004	104. 40	Longitudinally sawn anterior, C. ramosus.
005	9. 41	Inlay, flat disc.
005	10. 42	Inlay, plano-convex disc.
005	11. 43	Inlay, concave-convex disc.
005	20. 44	Inlay, flat, square/rectangular.
005	21. 45	Inlay, flat, quadrangular with concave sides.
005	19. 46	Inlay, flat, parallel sides, rounded ends.
005	37. 47	Inlay, flat, convex sides, parallel ends.
005	95. 48	Inlay, concave sided ellipsoid.
005	41. 49	Inlay, half circle.
005	40. 50	Inlay, half ellipse.

005	38. 51	Inlay, flat disc with incised circles.
005	42. 52	Inlay, other incised discs.
005	7. 53	Inlay, almond shape.
005	8. 54	Inlay, diamond shape.
005	22. 55	Inlay, petal shaped.
005	96. 56	Inlay, solid "pipal" leaf.
005	98. 57	Inlay, fretted scroll motif.
005	23. 58	Inlay, fretted, "Kidney" shape.
005	25. 59	Inlay, fretted, intersecting circle.
005	24. 60	Inlay, solid, "Kidney" shape.
005	27. 61	Inlay, solid, "T" or cross shaped.
005	26. 62	Inlay, fretted,"T" or cross shaped.
005	97. 63	Inlay, zig-zag or stepped line.
005	44. 64	Inlay, stepped cross or triangle.
005	28. 65	Inlay, other fretted designs.
005	29. 66	Inlay, other solid designs.
006	102. 67	Whole shell, body whorl removed.
007	4. 68	Shell "cap", 1/2 circle type.

007	4. 69	Shell "cap", 1/3 circle type.
007	4. 70	Shell "cap", tiny fragment.
007	49. 71	Cylinder, large solid.
007	45. 72	Cone, long pointed.
007	46. 73	Cone, short truncated
007	47. 74	Cone, short rounded.
007	48. 75	Cone, short concave sided.
007	50. 76	Cylinder, short perforated, squared pattern.
007	51. 77	Cylinder, short perforated, wavey band.
007	52. 78	Cylinder, short perf., wavey band, rounded.
007	53. 79	Cylinder, short perf., wavey band/flat base.
007	58. 80	Sphere, plain.
007	57. 81	Sphere, with incised cirles.
007	56. 82	Reworked bangle fragment.
007	43. 83	Cart wheel, or large perforated,incised disc.
007	81. 84	Hollowed/incised container, _C_. _ramosus_.
007	80. 85	Hollowed/incised container, _Turbinella_ _pyrum_
008	84. 86	Perforated, _L_. _marginalis_.

007	87. 87	Carved and incised figurine fragments.
007	94. 88	Other miscellaneous ground/carved fragments.
007	103. 89	Sawn and ground, half ring.
007	85. 90	Shell scraper, other species.
007	86. 91	Concave-convex disc, three perforations.
007	108. 92	Whole shell, perforated at apex, *T. pyrum*.
008	68. 93	Columella, chipped/sawn anterior tip.
008	67. 94	Columella, partly ground.
008	101. 95	Sawn columella piece.
008	77. 96	Collumella, sawn for making planks.
008	55. 97	Sawn plank.
008	18. 98	Circular chipped disc, unperforated
008	17. 99	Circular chipped disc, perforated by tubular drill.
008	70.100	Chipped body whorl.
008	79.101	Sawn nodes, *Lambis truncatta sebae*.
008	71.102	Sawn body whorl/outer lip, *L.t.sebae*.
008	72.103	Chipped body whorl/outer lip, *L.t.sebae*.

008	73.104	Sawn fingers, L.truncatta sebae.
008	74.105	Chipped fingers, L.truncatta sebae.
008	75.106	Sawn/chipped inner body whorl, L.t.sebae.
008	107.107	Sawn spire, L.truncata sebae.

APPENDIX III: SHELL ARTIFACT TABULATIONS FROM EACH SITE

III:1. MEHRGARH: MARINE SHELL SPECIES FROM EACH PERIOD

SPECIES	PERIOD I	II	III	IV	V-VII
Nerita,sp.	X		X		X
Littorina coccinea	X				
Terebellum terebellum	X				
Strombus,sp.		X			X
Erosaria ocellata		X			X
Natica lineata					
Polinices tumidus		X	X	X	X
Engina mendicaria	X				
Turbinella pyrum	X	X	X	X	X
Oliva bulbosa					X
Conus,sp.	X				X
Telescopium telescopium			X		
Gastropod	X	X?			
Dentalium,sp.	X	X	X		X
Arca,sp.		X		X	
Pinctada,sp.	X				
Spondylus exilis	X				
Cardium assimile	X				
Cardium/Arca,sp.?	X	X			
Callista impar	X				
Donax,sp.	X				X
Bivalve	X	X?	X		
Undetermined		X			

III:2. MEHRGARH, SHELL ARTIFACT TYPES IN EACH PERIOD

SPECIES	Nerita,sp.	L. coccinea	T. terebellum	Strombus,sp.	Erosaria ocellata	Natica lineata	Polinices tumidus	Engina mendicaria	Turbinella pyrum	Oliva bulbosa	Conus,sp.	T. telescopium	Gastropod	Dentalium,sp.	Arca,sp.	Pinctada,sp.	Spondylus exilis	Cardium assimile	Cardium/Arca,sp.?	Callista impar	Donax,sp.	Bivalve	Undetermined
BEAD, Cylinder Disc																	1		1				
Cylinder													1	1-7	1				1 2				
Tabular									1										1 2				
Irregular											1					1			1				
PENDANT, Shaped											1					1 2	1					1	
Natural Shell	1 3 6 7	1	1		2	6 7	2 3 4 5 6	1		5 6 7	6 7						1	1		1	1 6 7		
BANGLE, Plain									1 2 3														
Grooved									3														
INLAY, ?																							2
COLUMELLA, chippec				2																			
perforatec				2 5																			
OTHER, sawn fragments									3														
unworked fragments												3	2		2 4			1			1		3
natural shell							3																

III:3. AMRI; SHELL ARTIFACTS FROM EACH PERIOD.

ARTIFACT	Period / Mound	IA-D A	IA-D B	IIA,B A	IIA,B B	IIIA,B,C A	IIIA,B,C B	IIID A	VA A
BEADS, Cylinder Disc*									
species ?		X				X			X
PENDANT, Natural Shell									
*Tibia insulaechorab**		X							
Nerita,sp.*		X				X			X
Polinices tumidus		1							
Conus,sp.		2							
Natica lineata		1							
Cypraea,sp.*		X							3
Lamellidens marginalis						3			
BANGLE, plain									
Turbinella pyrum		20	3	1	1	19	2	0	36
RING, Finished,									
Turbinella pyrum		3	1						2
Unfinished,									
Turbinella pyrum		2							
LADLE, unfinished,									
Chicoreus ramosus						1			
MANUFACTURING WASTE									
Sawn columella,									
Turbinella pyrum						1			
Chipped and ground,									
Turbinella pyrum		2							
Lambis truncata sebae						?			
OTHER, broken fragment									
Oliva bulbosa						?			
Cyrena,sp.*		X							

* Reported in Casal,1964:49.

III:4. MOHENJO DARO: SHELL SPECIES REPRESENTED.

SPECIES	Unworked	Operculum	Broken/Fragment	Perforated	Ornament	Bangle	Ladle	Inlay	Figurine	Other Objects
Turbo, sp.		X								
Nerita albicilla	X			X						
Nerita polita	X			X						
Littorina scabra	X									
Turritella torulosa	X									
Vermetus sulcatus	X									
Telescopium telescopiu	X		X							
Terebralia palustris	X		X							
Cerithium morus	X									
Tibia insulaechorab	X		X							
Lambis truncata sebae	X			X				X	X	X
Erosaria turdus	X		X	X						
Peribolus(A.)grayana	X		X	X						
Polinices tumidus				X						
Chicoreus ramosus					X	X	X	X	?	?
Chicoreus brunneus			X							
Thais, sp.	X									
Babylonia spirata	X									
Engina mendicaria	X									
Pugilina buchephala			X		?	X		?		
Fasciolaria trapezium	X		X			?		X		X
Turbinella pyrum	X		X		X	X		X	X	X
Oliva bulbosa	X			X						
Conus, sp.	X		X	X						
Stephanoconus ebraeus				X						
Anadara granosa	X		X	X						
Anadara antiquata	X		X	X						
Pinctada margaritifera			X							
Chlamys townsendi			X	X						
Spondylus exilis			X							
Tivela damoides			X							
Dosinia ceylonica			X							
Parreyssia favidens	X		X							
Lamellidens marginalis	X		X	X						

III:5. MOHENJO DARO: SHELL ARTIFACT TABULATION, GENERAL CATEGORIES.

ARTIFACT TYPE	DM AREA	ALL OTHER AREAS	SURFACE SURVEY	TOTAL	PERCENT
ORNAMENTS:					
beads & pendants	0	144	33	177	6.2
bangles	13	422	150	585	20.5
rings	0	20	0	20	.7
Unfinished Ornaments*	1	28	3	32	1.1
Unfinished Bangles	1	44	28	73	2.5
Bangle Man. Waste	21	305	217	543	19.0
LADLE:					
Finished	4	177	44	225	7.9
Unfinished	1	24	5	30	1.0
Manufact. Waste	0	8	5	13	.5
INLAY:					
Finished	5	423	33	461	16.1
Unfinished*	9	34	9	52	1.8
OTHER OBJECTS:					
Finished	4	168	34	206	7.2
Unfinished*	5	286	112	403	14.1
Unworked shell	0	39	0	39	1.4
TOTAL	64	2122	673	2859	100.0

* Unfinished and Manufacturing waste

III:6. MOHENJO DARO BANGLE WIDTHS (EXCAVATED SAMPLE)

Interval cm			Number	Percent
.00	<	.20	5	1.080
.20	<	.40	44	9.560
.40	<	.60	93	20.217
.60	<	.80	64	13.914
.80	<	1.00	60	13.043
1.00	<	1.20	74	16.086
1.20	<	1.40	24	5.217
1.40	<	1.60	13	2.826
1.60	<	1.80	16	3.478
1.80	<	2.00	2	0.434
2.00	<	2.20	16	3.478
2.20	<	2.40	5	1.080
2.40	<	2.60	6	1.304
2.60	<	2.80	2	0.434
2.80	<	3.00	4	0.869
3.00	<	3.20	3	0.652
3.20	<	3.40	13	2.826
3.40	<	3.60	11	2.391
3.60	<	3.80	1	0.217
3.80	<	4.00	0	0.000
4.00	<	4.20	3	0.652
4.20	<	4.40	1	0.217
4.40	<	4.60	0	0.000
4.60	<	4.80	0	0.000
4.80	<	5.00	0	0.000
5.00	<	5.20	0	0.000
		TOTAL	460	100.000

STATISTICS All data

N		460.0
Mean		1.09 cm
Variance		.73
Std. dev.		.85
Range:	Min:	.1 cm
	Max:	4.2 cm

III:7. MOHENJO DARO: SURFACE SURVEY, BANGLE WIDTHS

Interval cm		Number	Percent
.00 <	.20	0	0.000
.20 <	.40	15	8.523
.40 <	.60	33	18.750
.60 <	.80	35	19.886
.80 <	1.00	18	9.227
1.00 <	1.20	28	15.909
1.20 <	1.40	15	8.523
1.40 <	1.60	8	4.545
1.60 <	1.80	2	1.136
1.80 <	2.00	0	0.000
2.00 <	2.20	5	2.841
2.20 <	2.40	7	3.977
2.40 <	2.60	1	0.568
2.60 <	2.80	2	1.136
2.80 <	3.00	1	0.568
3.00 <	3.20	3	1.705
3.20 <	3.40	1	0.568
3.40 <	3.60	1	0.568
3.60 <	3.80	1	0.568
3.80 <	4.00	0	0.000
4.00 <	4.20	0	0.000
	TOTAL=	176	100.000

Statistics

		All data
N		176.0
Mean		1.03840 cm
Variance		.50158
Std. dev.		.70823
Range,	Min:	.2 cm
	Max:	3.7 cm

III:8. MOHENJO DARO: Shell artifacts recorded from DM Area Field Register, compared with the actual artifacts.

FIELD REGISTER		CORRESPONDING ARTIFACT
#	Description	Description
9	1 conch shell	1 bangle manufacturing waste, sawn
21	3 bangle fragments	1 bangle man. waste, sawn
	2 shell fragments	
27	1 bangle fragment	1 bangle fragment
32	1 bangle fragment	1 bangle fragment
38	toy rhino	1 bangle man. waste, sawn
45	1 bangle fragment	3 bangle fragments
51	1 bangle fragment	1 bangle fragment
		1 chipped shell fragment
		1 bangle man. waste, sawn
53	pottery	1 chipped shell fragment
58	4 bangle fragments	1 bangle man. waste, sawn
59	1 bangle fragment	1 bead, unfinished
69	pottery	1 bangle man.waste, sawn
		1 inlay? fragment
75	1 bangle fragment	1 inlay waster, sawn
77	core of shell	1 bangle fragment
86	shell fragment	2 bangle man. waste, sawn
92	shell disc	1 inlay, flat disc
99	1 bangle fragment	1 shell "cap" fragment
100	shell	1 bangle man. waste, sawn
		1 chipped spine, *C. ramosus*
		1 chipped fragment

112	1 bangle fragment	3 bangle fragments
118	1 bangle fragment	1 bangle man. waste, chipped
	shell fragment	1 sawn columella, _T.pyrum_
		1 ladle fragment
121	shell	1 chipped shell fragment
		1 disc fragment
123	mother of pearl	1 tubular drilled waster
	shell fragment	1 partly drilled fragment
124	mother of pearl	1 bangle man. waste, sawn
	bangle fragments	1 bangle fragment
		3 inlay man. waste
138	shell fragments	1 bangle man. waste, chipped
		1 bangle man. waste, sawn
139	shell beads	1 ladle fragment
144	1 bangle fragment	1 bangle man. waste, sawn
145	1 shell fragment	1 inlay man. waste
156	mother of pearl	1 inlay, fretted design
162	shell fragment	1 bangle man. waste, sawn
	1 bangle fragment	1 inlay man. waste, sawn
163	1 bangle fragment	1 bangle fragment
165	shell	1 sawn digitations,_Lambis_,sp.
175	shell fragments	1 bangle man. waste, sawn
		1 cup fragment, incised
176	no shell recorded	2 incised fragments
183	1 bangle fragment	1 lnlay man. waste, sawn
	shell fragment	1 man. waste, sawn
215	cup fragment	1 ladle fragment

232	1 bangle fragment	1 bangle fragment
243	pottery,t/c cone	1 bangle man. waste, sawn
253	shell with X on back	1 inlay man. waste, sawn
263	3 shell fragments	1 inlay piece
296	t/c bull figurine	1 bangle fragment
306	shell	1 ladle fragment
	shell	1 man. waste, chipped

Total 64 artifacts

III:9. MOHENJO DARO; WIDTH OF SAW CUTS ON SHELL WASTERS.

	N	Mean(mm)	St.D.	Min.	Max.	Estimated Saw Width*
Bangle Manufacture	66	.76	.31	.3	1.8	.51
Ladle Manufacture	2	.55	.07	.5	.6	.37
Inlay Manufacture	4	1.05	.17	.8	1.1	.72
Tubular Drill (flat discs)	2	.65	.07	.6	.7	.44
Incised lines (shell "caps")	65	.89	.27	.5	2.0	.61

*See Appendix IV:1. Ratio of saw width to minimum saw cut width is 1: 1.45.)

III:10a. HARAPPA; SHELL SPECIES REPRESENTED.

SPECIES	Unworked	Broken/Fragment	Perforated	Ornament	Bangle	Ladle	Inlay	Figurine	Other Objects
Chicoreus ramosus		X		X	X	X	X	?	X
Chicoreus brunneus						X			
Fasciolaria trapezium		X					X		X
Turbinella pyrum		X		X	X		X	X	X
Lambis Truncata sebae		X					X	X	X
Dentalium, sp.*	X			X					
Anadara antiquata		X							
Cardita bicolor	X								
Lamellidens marginalis	X	X	X						

*Reported by Beck in Vats,1940.

III:10b. HARAPPA:SHELL ARTIFACT TABULATION,
GENERAL CATEGORIES.

ARTIFACT TYPE	TOTAL	PERCENT
ORNAMENTS:		
beads & pendants	21	6.5
bangles	57	17.5
rings	0	.0
Unfinished Ornaments*	0	.0
Unfinished Bangles	6	1.8
Bangle Man. Waste	32	9.9
LADLE:		
Finished	14	4.35
Unfinished	6	1.8
Manufact. Waste	0	.0
INLAY:		
Finished	75	23.2
Unfinished*	0	.0
OTHER OBJECTS:		
Finished	41	12.7
Unfinished*	40	12.35
Unworked shell	32	9.9
TOTAL	324	100.0

* Unfinished and Manufacturing waste

III:11. HARAPPA BANGLE WIDTHS

Interval cm			Number	Percent
.00	<	.20	0	0.0
.20	<	.40	6	9.524
.40	<	.60	17	26.984
.60	<	.80	8	12.698
.80	<	1.00	13	20.635
1.00	<	1.20	7	11.111
1.20	<	1.40	3	4.762
1.40	<	1.60	0	0.0
1.60	<	1.80	1	1.587
1.80	<	2.00	1	1.587
2.00	<	2.20	2	3.175
2.20	<	2.40	1	1.587
2.40	<	2.60	0	0.0
2.60	<	2.80	1	1.587
2.80	<	3.00	0	0.0
3.00	<	3.20	0	0.0
3.20	<	3.40	1	1.587
3.40	<	3.60	0	0.0
3.60	<	3.80	0	0.0
3.80	<	4.00	0	0.0
4.00	<	4.20	0	0.0
4.20	<	4.40	0	0.0
4.40	<	4.60	2	3.175
4.60	<	4.80	0	0.0
4.80	<	5.00	0	0.0
5.00	<	5.20	0	0.0
		TOTAL	63	100.0

STATISTICS — All data

N		63.0
Mean		1.0 cm
Variance		.75
Std. dev.		.87
Range:	Min:	.27 cm
	Max:	4.50 cm

III:12. HARAPPA; WIDTH OF SAW CUTS ON SHELL WASTERS.

	N	Mean (mm)	St.D.	Min.	Max.	Estimated Saw Width*
Bangle Manufacture	9	1.12	.33	.7	1.8	.77
Ladle Manufacture	2	1.05	.35	.8	1.3	.72
Inlay Manufacture	8	.9	.15	.9	1.2	.62
Incised lines (shell "caps"	12	1.0	.26	.7	1.5	.68

*See Appendix IV:1. Ratio of saw width to minimum saw cut width is 1: 1.45.)

III:13. BALAKOT; SHELL SPECIES REPRESENTED

Species	Unworked	Broken/Fragment	Perforated	Ornament	Bangle	Ladle	Other Objects
Acmaea profunda	X						
Umbonium vestiarium	X						
Nerita polita	X						
Turritella torulosa	X	X					
Telescopium telescopium	X	X					
Terebralia palustris	X	X					
Cerithium morus	X						
Tibia insulaechorab	X	X					
Cypraea, sp	X	X					
Erosaria turdus	X	X					
Cypraea moneta			X				
Peribolus(A.)grayana	X	X					
Polinices tumidus	X		X				
Natica lineata	X	X					
Bursa bardeyi		X					
Tonna olearium		X					
Chicoreus ramosus						X	
Murex tenuspina	X						
Thais, sp.		X					
Thais rudolphi	X	X					
Thais persicum	X	X					
Babylonia spirata	X	X					
Fasciolaria trapezium		X					X
Turbinella pyrum		X		X	X		X
Pugilina buchephala				?	X		
Oliva bulbosa		X	X				
Oliva sericea		X	X				
Lophotioma acuta		X					
Conus cf. betulinus		X		X			
Gastropod, sp.		X					
Dentalium octangulatum	X	X		X			
Anadara granosa	X	X					X
Anadara sp.	X	X	X				
Anadara antiquata	X	X					X
Chlamys townsendi		X					
Spondylus exilis		X					
Placuna placenta	X	X					
Pinctada, sp.							X
Crassostrea madrasensis	X	X					
Saccostrea culcullata	X	X					
Cardita bicolor	X						
Cardium assimile		X					
Tivela damaoides	X	X			X		
Meretrix ovum	X	X					
Callista impar	X	X			X		
Dosinia, sp.	X	X					
Gari cf. occidens		X					
bivalve, species ?			X				

III:14. BALAKOT; MARINE SHELL ARTIFACTS, PERIOD II.

ARTIFACT TYPE	PERIOD II	II & Surface
Bead	13	
Pendant,		
Perforated Shell	12	4
Bangle, gastropod	201	X
bivalve	463	X
Ring	0	
Unfinished Ornament	0	
Unfinished Bangle,gastropod	30	X
,bivalve	232	X
Bangle manufacturing waste,		
gastropod	75	6
bivalve	903	X
Ladle	2	
Unfinished Ladle	1	
Ladle manufacturing waste	0	
Inlay	0	
Inlay manufacturing waste	0	
Other Objects	8	
Other Manufacturing waste	12	3
Unworked shell, bivalve	155	
, other species	203+	96

III:15. BALAKOT: GASTROPOD BANGLE WIDTHS.

Interval cm		Freq	Percent
.00 :	.20	2	.905
.20 :	.40	84	38.009
.40 :	.60	83	37.557
.60 :	.80	38	17.195
.80 :	1.00	10	4.525
1.00 :	1.20	3	1.357
1.20 :	1.40	0	.000
1.40 :	1.60	0	.000
1.60 :	1.80	0	.000
1.80 :	2.00	0	.000
2.00 :	2.20	0	.000
2.20 :	2.40	1	.452
2.40 :	2.60	0	.000
2.60 :	2.80	0	.000
2.80 :	3.00	0	.000
	TOTAL=	221	100.000

Statistics

		All Data
N		221.0
Mean		.46127 cm
Variance		.04493
Std. Dev.		.21196
Range,	Min:	.13 cm
	Max:	2.3 cm

III:16. BALAKOT; Experimental study of Tivela damaoides bangle maufacture.

The Replicative Experiment

An experimental replication of the manufacturing process was conducted to demonstrate and better understand the stages of manufacture observed from the analysis of the ancient shell wasters. This experiment would also provide a known sample of shell fragments, wasters, unfinished and finished artifacts which could be used for comparison with the excavated sample. The replicative experiment was carried out using grinding stones, hammerstones and chert blades found on the eroded surface around the site. The shells used in the manufacture were unworked ancient specimens found in a cache in the uppermost levels of the site. Despite the fact that these shells were not fresh, later comparisons with modern specimens indicates that they were only slightly more brittle than fresh shells would have been.

A total of six shells were worked in the preliminary experimentation, during which some of the more obvious factors contributing to breakage were encountered. In chipping the ventral margin of the shell (stage one), striking from the exterior or lateral face resulted in irregular and uncontrolled flake removal. The cleavage planes created by the growth layers of the shell were an important factor that had to be taken into account during any of the chipping stages. Consequently, flaking of the

ventral margin could be better controlled by striking from the medial face with the support of an anvil stone. In chipping the center hole (stages 4 and 7) an anvil stone was not efficient because of the delicate nature of the flaking. The best results were achieved by holding the shell in one hand to provide a cushioned support. However, chipping could only be done after a suitable striking platform had been prepared by grinding the top surface of the shell. Alternating stages of grinding and chipping eventually resulted in a fully enlarged central hole.

Several different shapes and weights of hammerstones were experimented with until it was decided that a bi-conical pebble with only a slightly rounded point was the most effective shape. Hammerstones used in the experiment weighed from 19 to 36 grams. Any stone that was heavier or lighter, resulted in breakage due to awkwardness or impatience in the chipping process.

The striae on ancient shell fragments resulting from grinding were compared with experimental results using several types of querns and different available grades of sand. A slightly concave quern was more effective in heavy grinding than a flat quern because it is easier to recycle the sand abrasive by using a continuous circular grinding motion. The slight grade in the grinding platform also served as an aid in this circular, back and forth movement. Coarse grained sandstone querns used without any sand abrasive produced rough irregular striae and proved very

ineffective. By adding sand and water, the fluid abrasive facilitated a more or less continuous grinding process and resulted in much finer striae on the ground surface of the shell. Coarse sand from the beach was found to be more effective than the silty wind-blown sand found around the site.

Two methods of incising were used, one with an unretouched chert blade fragment and the other using an iron file. The irregular line and "V" shaped section produced by the chert blade was identical to the cuts seen on the ancient incised fragments. Incising on the Turbinella pyrum bangles on the other hand, appears to have been done with a metal saw or toothed file since the lines are quite parallel and have a uniform, concave or squared section.

Before a bangle could be worn, the rough chipped edge on the interior of the circlet was ground smooth. In the experiment I used a cylindrical grinding stone, manipulating it much the same way that a rasp is used. Traditional shell workshops in Bengal use a similar tool, but it is a man made rasp constructed by coating a short wooden rod with a mixture of sand and lac (an insect resin). When the lac hardens, the result is essentially the same as a long cylindrical piece of sandstone, but they use it in a stationary position (passive) and move the bangles up and down. Actually this is a much more efficient method than moving the rasp and holding the delicate bangle at the same time.

After becoming familiar with some of the techniques necessary to produce these bangles, I cunducted a timed experiment where all details of the process were documented (see below). Shells were weighed and measured before and after the experiment, and all fragments of chipping were collected. The amount of sand and water used for each shell was also recorded and samples of the grinding wastes were collected for comparison with similar deposits found in shell working areas of the ancient site.

The results of this experiment are by no means conclusive, but they do give us a better idea of the time and materials involved in the manufacture of *Tivela* bangles. A single bangle could be produced after 1.5 to 2 hours of continuous labour. The number of broken shells/bangles to finished bangles for the entire experiment was about 62% (8 out of 13). The tiny chips resulting from the flaking were not counted in the calculation of manufacturing waste since this was not done for the excavated sample. However, any broken fragment of shell other than these tiny flakes was counted, and the percentage of manufacturing waste is 87.5% and finished pieces 12.5%. Most of the finished bangles in the ancient sample are broken, so the frequencies of the experimental sample are slightly different since each of the finished bangle from the experiment was counted only once.

TABLE 1. OBSERVATIONS ON SHELL MANUFACTURE; FINAL EXPERIMENT.

SHELL NUMBER	1	2	3	4	5	6	7
UNWORKED SHELL							
width (mm)	82	81	80	81	78	87	86
length	73	73	73	67	72	74	75
height	21	21	21	21	21	23	21
weight (grams)	53.	59.	55.	51.	59.	64.	88.
FINISHED BANGLE							
width	73	71	X	72	X	76	X
length	68	68	X	68	X	66	X
height	8	9	X	9	X	9	X
weight (grams)	15.	16.		17.		18.	
Chipping waste	16.	24.		20.	22.	26.	36.
Grinding waste	22.	19.		13.	13.	20.	26.
Sand used	420.	380.		320.	320.	320.	420.
Water (cups)	4	4		3	3	4	4
Quern, Flat	X	X	X				
Concave				X	X	X	X
TIME (minutes)							
grinding	75	75		60	60	90	90
chipping	30	30		30	30	30	30
Total Time	105	105		90	90	120	120

TABLE 2. SHELL FRAGMENTS FROM REPLICATIVE EXPERIMENT.

STAGE OF MANUFACTURE	#	%
1.	2	6.50
2.	1	3.22
3.	1	3.22
4.	4	12.90
5.	3	9.70
6.	1	3.20
7.	9	29.02
8.	5	16.12
9.	1	3.22
10.	4	12.90
TOTAL	31	100.00

III:17. LOTHAL: SHELL ARTIFACT TABULATION, GENERAL CATEGORIES.

ARTIFACT TYPE	TOTAL	PERCENT
ORNAMENTS:		
beads & pendants	218+	16.1
bangles	873	64.5
rings	3	.2
Unfinished Ornaments*	6	.4
Unfinished Bangles	31	2.3
Bangle Man. Waste	107	7.9
LADLE:		
Finished	16	1.2
Unfinished	4	.3
Manufact. Waste	8	.6
INLAY:		
Finished	12	.9
Unfinished*	7	.5
OTHER OBJECTS:		
Finished	30	2.2
Unfinished*	12	.8
Unworked shell	27	2.0
TOTAL	1354	100.0

* Unfinished and Manufacturing waste

III:18. LOTHAL; SHELL SPECIES REPRESENTED.

SPECIES	Unworked	Broken/Fragment	Perforated	Ornament	Bangle	Ladle	Inlay	Figurine	Other Objects
Nerita polita	X								
Telescopium telescopium		X							
Terebralia palustris		X							
Lambis lambis	X								
Erosaria turdus	X								
Chicoreus ramosus		X		X	X	X	X		X
Thais, sp.	X								
Turbinella pyrum				X	X		X	X	X
Conus, sp.	X								
Dentalium, sp.*	X			X					
Anadara antiquata	X								
Pinctada, sp.	X			X					
Chlamys, sp.		X							
Spondylus exilis		X							
Tivela damaoides					X				
Callista impar		X							
Meretrix meretrix		X							
Dosinia, sp.		X							
Lamellidens marginalis	X	X	X						

III:19. LOTHAL: BANGLE WIDTHS

Interval cm			Number	Percent
.00	<	.20	1	0.256
.20	<	.40	3	0.769
.40	<	.60	57	14.615
.60	<	.80	126	32.308
.80	<	1.00	96	24.615
1.00	<	1.20	57	14.615
1.20	<	1.40	21	5.385
1.40	<	1.60	14	3.590
1.60	<	1.80	5	1.282
1.80	<	2.00	2	0.513
2.00	<	2.20	4	1.026
2.20	<	2.40	2	0.513
2.40	<	2.60	1	0.256
2.60	<	2.80	0	0.000
2.80	<	3.00	0	0.000
3.00	<	3.20	1	0.256
3.20	<	3.40	0	0.000
3.40	<	3.60	0	0.000
3.60	<	3.80	0	0.000
3.80	<	4.00	0	0.000
4.00	<	4.20	0	0.000
		TOTAL=	390	100.000

Statistics

		All data	
N		390.0	
Mean		.861	cm
Variance		.13588	
Std. dev.		.36861	
Range,	Min:	.2	cm
	Max:	3.0	cm

III:20. BANGLES WITH UNIQUE DESIGNS.

ARTIFACT #	PROVENIENCE	(LEVEL)	PERIOD	DESIGN/SECTION
1. SRG2/4732	B8/C8 Baulk	(8)	A,III	
2. SRG2/15379	E 14	(4)	A,III or B,IV	
3. SRG2/7844	D 19,pit	(1)	B,IV ?	
4. SRG4/2837	Ax1	(7)	A,III ?	
5. SRG2/11951	K12/L12	(2)	B,IV ?	

III:21. LOTHAL; WIDTH OF SAW CUTS ON SHELL WASTERS.

	N	Mean (mm)	St.D.	Min.	Max.	Estimated Saw Width*
Bangle Manufacture	29	.8	.17	.5	1.3	.55
Incised lines (shell "caps")	12	.7	.16	.5	1.0	.45

*See Appendix IV:1 .Ratio of saw width to minimum saw cut width is 1: 1.45.)

III:22. ALLAHDINO; SHELL SPECIES REPRESENTED.

Species	Unworked	Broken/Fragment	Perforated	Ornament	Bangle	Ladle
Turbo coronatus*	X					
Nerita albicilla*	X					
Terebralia palustris*		X				
Strombus cf. tricornis*		X				
Erosaria turdus		X	X			
Erosaria ocellata*	X					
Peribolus(A.)grayana*		X				
Polinices tumidus*		X	X			
Ficus ficus*	X					
Chicoreus ramosus						X
Thais carinifera*	X	X				
Babylonia spirata*	X					
Turbinella pyrum*		X		X	X	
Oliva , sp.*	X					
Dentalium,sp.?		?		?		
Anadara granosa*	X	X				
Scapharca inaequivalvis*	X	X				
Tivela damaoides		X			X	
Callista impar	X	X			?	
Dosinia celonica*	X	X				
Marcia recens		X				

* Reported by Turnbull,1982.

APPENDIX IV:1 BENGAL; WIDTH OF SAW CUTS ON SHELL WASTERS.

	Saw Width	Saw width:Saw cut
Saw #6, Barrackpore	.55 mm	1 : 1.4
		N = 13
Saw #3, Bishnupur	.45 mm	1 : 1.5
		N = 7
		Mean = 1 : 1.45
		s.d =.07